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REPORT ON WASTES GENERATED BY SITE CLEAN-UP AND DECOMMISSIONING ACTIVITIES IN ONTARIO

Prepared for
Ontario Waste Management Corporation

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August 1988

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EXECUTIVE SUMMARY

PURPOSE OF THE REPORT

The purpose of this report is to quantify, to the extent possible, quantities of subject waste which will be produced by site decommissioning and clean-up activities in Ontario in the future.

SCOPE AND METHOD

Information on wastes produced by these activities at present was obtained by an extensive telephone survey of Ontario Ministry of the Environment (MOE) District and Regional offices, industry contacts, consultants involved in decommissioning and site clean-up work, members of the MOE Waste Management Branch, and also the Federal Environmental Protection Service (EPS). This information was then summarized on tables which were circulated to all the MOE offices for additional comments.

Information on jurisdictions in the U.S. was obtained through a literature search, and also through direct telephone contact with members of the USEPA (United States Environmental Protection Agency), a number of CH2M HILL staff members in the U.S., members of the New Jersey Department of Environmental Protection (DEP) and members of the New York State Department of Environmental Conservation (DEC). Information was obtained on the history of environmental regulation in U.S., the impacts of various legislative efforts on the level of site clean-up activity, and trends in the approach to site clean-up, such as increasing attention to on-site treatment.

Information on potential future legislation in Ontario was obtained through discussions with various members of the Ontario MOE and the Federal EPS.

The above information was used to estimate to the extent possible quantities of waste which might be produced by site clean-up and decommissioning activities in Ontario in the future.

PREMISES AND POSTULATES

It was assumed for the purpose of the study that information obtained during telephone interviews with various government and private sector representatives was reasonably accurate.

STATUS OF DATA

Most of the data included in this report were obtained through telephone interviews. The data obtained are considered to be reasonably accurate. Data obtained on clean-up and decommissioning projects in Ontario are considered to be incomplete because of the confidentiality of many projects, and also the lack of detailed records on these topics.

Data obtained through references obtained in the literature are considered accurate.

MAIN FINDINGS

The main findings of this study are as follows:

1. Decommissioning activities in Ontario in 1986 and 1987 accounted for generation of approximately 190,000 tonnes of waste material, resulting in an average annual generation rate of 95,000 tonnes for these two years.

2. Of the above total, approximately 129,700 tonnes (68%) was oil contaminated soil, most of which was disposed and/or used as daily cover at municipal landfills. A further 44,000 tonnes (23%) was lime sludge, used as daily cover at a municipal landfill. Approximately 12,760 tonnes (7%) of this total was PCB contaminated soil or material, and is stored on-site at present. Approximately 970 tonnes (0.5%) of the total was classified as hazardous, and was disposed at Tricil.

3. Site clean-up activities in Ontario in 1986 and 1987 accounted for generation of an estimated 111,300 tonnes of waste material, resulting in an average annual generation rate of 55,650 tonnes for these two years.

4. Of the above two year site clean-up total, approximately 55,480 tonnes (56%) was PCB-contaminated soil. A further 28,200 tonnes (28%) was coal tar contaminated soil, and was disposed at licenced landfills. Approximately 4,150 tonnes (4%) was miscellaneous non-hazardous contaminated soils, and the remaining 11,285 tonnes (12%) was miscellaneous hazardous waste from a number of sources.

5. Decommissioning activities generally produce larger volumes of less contaminated material than site clean-up, which generates a higher percentage of subject waste.

6. A number of regulations and legislative measures under consideration at the moment could impact on the quantities of material produced by these activities in the future. These are:

   - o Federal Canadian Superfund development
   - o Provincial decommissioning guideline development
   - o Federal decommissioning guideline development

   Increasing concern about the liabilit associated with contaminated property in real estate t ansactions, and increased pressure to redevelop former industrial downtown properties is expected to increase the level of clean-up activity in the future.

7. Experience in the U.S. in site decommissioning and clean-up can not be directly applied to Ontario at this time because of a number of factors. Major forces at play in some U.S. states which are different to Ontario include:

   - o Substantial funding for clean-up activities through Federal and State Superfunds
   - o Substantial efforts at problem identification through comprehensive inventories
   - o Regulatory requirements to clean-up industrial properties prior to sale

- Increased awareness and major concern with the future liability associated with environmental contamination

8. Two methodologies were used to estimate future waste quantities produced by site clean-up and decommissioning activities in Ontario. In both cases, existing identified quantities were used as a base case. As the identified quantities were considered incomplete, both methodologies provide a conservatively low estimate of future activity.

9. The above methodologies estimated a future annual production of 92,400 - 120,000 tonnes per year of waste from decommissioning activity. Most of this material is expected to be contaminated soil. Preliminary estimates indicate that approximately 4,900 tonnes of this total would be subject waste, of which 3,400 tonnes would be PCB waste, and an additional 1,500 tonnes would be organic, inorganic and mixed waste.

10. The above methodologies estimated future annual waste production from site clean-up activities at 82,100 to 112,000 tonnes per year. Approximately 20,700 tonnes of this total is expected to be subject waste, of which 9,600 tonnes is expected to be PCB related, with the remaining 11,100 tonnes consisting of organic, inorganic and mixed wastes.

11. The majority of waste from these activities is contaminated soil, which is currently disposed at licenced landfills. It is possible that this practice may change in the future, because of concerns regarding municipal landfill capacity and future environmental impacts associated with placement of contaminated materials in a municipal landfill. If current practice

were to change handling and disposal of this material would present a problem. Because of the large volumes involved, it is likely that onsite treatment would develop. However, in some cases disposal at a hazardous waste facility may be required, because of the lack of available options.

RECOMMENDATIONS

1. This report should be updated at least every two years to reflect regulatory and other changes which impact on the level of site clean-up and decommissioning activities.

Chapter 1
INTRODUCTION

This chapter includes descriptions of the purpose of the study, and of the report structure.

1.1 BACKGROUND

The Ontario Waste Management Corporation (OWMC) was established as a provincial Crown Agency in 1981 with a mandate for the implementation of a province-wide program for the management of hazardous and liquid industrial waste as currently defined in Regulation 309 and referred to as "subject waste" or simply "waste" in this study.

A critical component of the OWMC FDP (Facilities Development Program) program involved the assessment of the types and quantities of subject wastes generated in Ontario. The assessment data will be used to support planning of waste management facilities to be built by OWMC, and also of programs that will affect the generation and management of waste, such as encouragement of recovery, recycling and re-use practices.

1.2 OBJECTIVES

As part of the data collection effort, Victor and Burrell retained CANVIRO Consultants on behalf of the OWMC to undertake a study to estimate the quantities of subject wastes generated in Ontario by site clean-up and decommissioning activities.

The study involved a compilation of available information on waste generated by these activities in Ontario at present, an examination of trends towards an increase in this activity

in other jurisdictions, and an estimate, to the extent possible, of future trends and quantities of material likely to be produced by this activity in Ontario in the future.

1.3 REPORT STRUCTURE

The methodology employed in conducting the study is described in Chapter 2. Current decommissioning and site clean-up activity in Ontario, and some likely future trends are discussed in Chapter 3. Chapter 4 discusses study findings, and conclusions and recommendations derived from the study are presented in Chapter 5. Appendices to the report include references, a bibliography, a list of people contacted during the course of the study, relevant information obtained from referenced studies, and a detailed rational for future projections.

Chapter 2
STUDY METHODOLOGY

This chapter describes the various sources from which information contained in the study was obtained, and the methodology employed to project future quantities of waste, based on existing identified levels of activity in site clean-up and decommissioning.

2.1 GENERAL

The methodology adopted to estimate future quantities of material produced by decommissioning and site clean-up activities is follows:

- To the extent possible, quantities of material produced by these activities in Ontario at present were identified.

- A number of factors were reviewed which could impact on the level of decommissioning and clean-up activity in Ontario in the future, including regulatory and legislative issues, trends towards increased source reduction and on-site treatment and increased awareness of environmental liability issues.

- Trends experienced in the U.S. were addressed to assess their applicability to Ontario in the future.

- The above factors were combined to estimate, to the extent possible, the quantities of material which may be produced by site clean-up and

decommissioning activities in Ontario in the future, using identified current quantities as a base case, and exercising best professional judgement to project future trends.

- Two methodologies were used to carry out this task. The first methodology estimated a general expected level of increased activity for decommissioning and site clean-up activities based on results of discussions with industry and government representatives. The second methodology carried out a similar exercise for each type of site clean-up and decommissioning project, and aggregated the results to come up with a total.

2.2 DATA COLLECTION

2.2.1 TELEPHONE INTERVIEWS

Most of the data used in this study was compiled through an extensive telephone survey of a number of contacts. Each of these is briefly discussed below, along with the data sought through the telephone interview. A list of people contacted during the telephone survey is included in Appendix 'C'.

Ministry of the Environment District and Regional Offices

Each of the 21 MOE District Offices and the 6 MOE Regional Offices in the Province was contacted and discussions held with one or more abatement officers involved in industrial and other clean-up projects. Information was obtained on any past, present or future decommissioning and site clean-up activity planned for the area within their jurisdiction. Where available, quantities and types of material involved were obtained, along with the method of disposal for each.

This information was summarized in tabular form and sent to each of the MOE District Offices for further additions and comments.

Industry

A number of industries were contacted directly to obtain information on specific sites which had been, were being or would be decommissioned in the foreseeable future. In many cases industry contacts were provided by MOE staff.

MOE Waste Management Branch

MOE Waste Management Branch representatives were contacted to discuss a number of issues related to the study topic. These include:

- Status of inventories of various site types
- Status of "Decommissioning Guidelines"
- Status of MOE activities related to the CCREM (Canadian Council of Resource and Environmental Ministers) Hazardous Waste Action Plan
- Status of Approval of various on-site treatment technologies
- Potential for de-listing certain decommissioning and clean-up wastes
- Projected schedule for clean-up of various identified contaminated sites (eg. coal gasification sites)

Environmental Protection Service (EPS)

Representatives of the Federal EPS were contacted to obtain information on a number of topics including the status of:

- o National and Provincial inventories of potential clean-up sites
- o Development of National Guidelines for Decommissioning and Clean-up of sites
- o Potential Development of a Canadian National Superfund
- o Development of an Environmental Code of Practice for Underground Storage Tanks Containing Petroleum Products

CH2M HILL

CH2M HILL have been involved in a number of U.S. Superfund projects, and work closely with the USEPA on a number of other Superfund activities. A number of staff members at CH2M HILL offices in the U.S. were contacted to discuss trends in the U.S. with respect to a number of regulations, including CERCLA (Comprehensive Environmental Response Compensation Liability Act), RCRA (Resource Conservation and Recovery Act), and SARA (Superfund Amendment Act), and legislation such as New Jersey's ECRA (Environmental Clean-up and Responsibility Act.)

Trends related to on-site treatment and the ban on land-filling of untreated waste were also discussed along with the impacts that these might have on future waste quantities produced from remedial projects.

Industry Associations

Some industry associations such as PACE (Petroleum Association for the Conservation of the Environment) were contacted to obtain information on trends in the industry with regard to decommissioning and site clean-up activities.

U.S. EPA Contacts

A number of members of the USEPA were contacted to discuss projections which were carried out on capacity needs assessments for hazardous waste handling facilities as a result of anticipated increased activity in clean-up of Superfund and other hazardous waste sites. Past trends, and the extent to which enactment of CERCLA (Superfund) has impacted the quantities of hazardous material produced in the U.S. were also discussed.

New York State

A number of members of the New York State Department of Environmental Conservation (DEC) were contacted to discuss the level of decommissioning and site clean-up activity in this state over the last ten years, and also projections of activity for future years.

State of New Jersey

A number of members of the State of New Jersey Department of Environmental Protection were contacted to discuss the level of clean-up activity observed in this state prior to 1980, and also post-1980 (when Superfund enacted) and post-1983 (when ECRA enacted).

2.2.2 LITERATURE SEARCH

Literature searches were conducted in-house using the Canadian Institute for Scientific and Technical Information (CISTI), Canadian Online Enquiry (CAN/OLE) System. Database selection was based on CANVIRO's past experience conducting literature searches. Specific databases examined included:

EI	Engineering Index
EIM	EI Engineering Meetings
ELIAS	Environmental Libraries Automated System
MICROLOG	Microlog Index
NTIS	National Technical Information Service
OON	Cisti Catalogue Online

Abstracts obtained as a result of the literature searches were carefully reviewed and a number of references containing pertinent information were ordered and reviewed. A listing of references reviewed is included in Appendix A.

2.2.3 WORKSHOPS

A workshop was held on the study topic on November 27, 1987, to review the work carried out to that time, and also obtain additional input from workshop attendees. Representatives from OWMC, MOE Waste Management Branch, Monenco, Gartner Lee, MM Dillon, Victor and Burrell, J.E. Hanna Associates, and CANVIRO attended the initial workshop. Future trends in utilization of various on-site treatment technologies were discussed.

A second workshop was held on February 18, 1988 to review the contents of a preliminary draft report developed as part of the project, and also to elicit further comment on a number of related topics. The second workshop was attended by representatives from OWMC, J.E. Hanna Associates, CH2M HILL, Trow, Dames and Moore, Maclaren Engineers, SENES, Monenco, Gartner Lee and CANVIRO.

Chapter 3
PRESENT DECOMMISSIONING AND SITE CLEAN-UP ACTIVITIES IN ONTARIO, AND LIKELY FUTURE TRENDS

This chapter includes definitions of decommissioning and site clean-up which will be used in this study. Current regulations governing these activities in Ontario are discussed along with potential future regulations. A review of current site clean-up and decommissioning activities in Ontario is presented, and some likely future trends are briefly discussed.

3.1 DEFINITION OF DECOMMISSIONING AND SITE CLEAN-UP

Decommissioning

For the purpose of this study, decommissioning is being defined as an activity which occurs when a plant or operation closes down and is almost an extension of the operations phase of the facility. By this definition, the requirement to decommission is identified while the plant is still in operation. Examples of this type of project would include the decommissioning of the Shell and Texaco Refineries.

Site Clean-up

For the purpose of the study, site clean-up will be defined as any project which was not planned as part of a plant operational phase and is generally initiated as a result of discovery. This would include old coal gasification site clean-ups, such as the projects in Waterloo, Ottawa, and Chippawa Creek; PCB clean-ups such as Pottersburg Creek; former waste handling facilities such as Smithville and projects such as the South Riverdale clean-up. Clean-ups

on-going at existing operational facilities have been classified as site clean-up rather than decommissioning activities. Clean-up of leaking underground storage tanks (LUSTS) could be classified as either decommissioning or clean-up, but will be classified as clean-up for the purpose of this study.

3.2 DECOMMISSIONING AND SITE CLEAN-UP REGULATIONS

Decommissioning and clean-up activities come under the jurisdiction of the Environmental Protection Act (EPA) and the Ontario Water Resources Act (OWRA). In addition, environmentally related municipal by-laws may also apply in some cases. The level of clean-up required is generally a function of the future intended use of the site, and any existing or potential impacts of site contamination on the environment outside the property boundaries. Each site is dealt with on a case by case basis in consultation with MOE representatives.

Draft guidelines for decommissioning of industrial sites were developed in 1984, and have been finalized by MOE staff. At the time of writing of this report (August 1988) it was reported that the Provincial Decommissioning Guidelines would be available to the public when the policy was signed by the Minister of the Environment, anticipated to be within a short period of time.

In addition to the Provincial initiative to develop guidelines for clean-up of sites, National Decommissioning Guidelines are being developed as part of the CCREM (Canadian Council of Resource and Environment Ministers) Hazardous Waste Action Plan and should be available by 1989.

3.3 SITE TYPES TYPICALLY REQUIRING DECOMMISSIONING AND CLEAN-UP

The types of sites which require decommissioning and clean-up vary widely from one year to the next, depending on economic factors which result in plant closures, and discoveries of contamination. In the last few years PCB clean-ups and also clean-up of old coal gasification sites have received a lot of attention. The petrochemical industry has also systematically closed a number of facilities. These and others are discussed in this section along with brief comments on future trends envisaged for a number of these site types.

The term oil contaminated soil is used extensively in the text and refers to soil contaminated with a number of different petroleum based products, including oils and gasoline.

3.3.1 OIL REFINERIES

The Province of Ontario has a total of nine (9) oil refineries of which two (2) have been closed within the last four years. The Shell Refinery in Oakville was closed in 1983 and the major decommissioning effort was carried out between 1983 and 1986. Remediation of some of the property is still in progress, and is scheduled for completion in fall 1988. Decommissioning of the Texaco Refinery in Port Credit is still underway. Both refineries were reportedly closed because of declining market conditions.

Case Study - Decommissioning of Shell Canada's Oakville Refinery

In July 1983, Shell Canada ceased crude oil processing at its 7000 m^3/day refinery in Oakville. Table 3.1 provides a

Table 3.1
TREATMENT AND DISPOSAL METHODS USED FOR DECOMMISSIONING WASTES
AT THE SHELL OAKVILLE REFINERY

Waste Type	Action Type
Storage tank sludge and effluent plant bottom sludge	Treated by landfarming on-site. These landfarming beds were fertilized and frequently rototilled to allow natural soil bacteria to biodegrade oil and grease, 11,000 barrels (1,750 cu.m)
Contaminated surface water and water that flowed into the sewers from the concrete pads of the process units.	On-site treatment included a gravity oil separator to remove free oil, and storage ponds to impound water for testing prior to its release.
Refinery catalysts and chemicals (100 tonnes)	o Return to suppliers or transfer to another location o Reclamation of catalysts for metal recovery o Disposal at a licensed landfill
Tetraethyl lead (TEL) as well as TEL tank and associated piping.	The TEL was injected into the gasoline prior to sale. The tank and the associated piping was disposed through the supplier of the additive.
Leaded gasoline storage tank sludge (scale and rust)	During the operational life of refinery, this material along with material contaminated with lead during a spill was oxidized and treated on a lead bed licenced on-site. During decommissioning, 5 tonnes were excavated and disposed at a licensed hazardous waste landfill.
Asbestos insulation	Asbestos insulation (2,470 cu.m) was removed and disposed of at a licensed landfill.
On-site landfill. This contained building debris, alumina catalyst and inert building materials.	The site was excavated and 3,600 tonnes of material removed to a licenced landfill site.
Molybdenum contaminated soil	Disposed off-site at Steetly Quarry and another licenced landfill (10,000 tonnes)
Oil Contaminated Soil	Landfarmed on-site (9000 tonnes ±)

Reference: Shell Canada Limited, Toronto, "Environmental Aspects of Decommissioning of Shell Canada's Oakville Refinery", October, 1986. Personal communication, Murray Jones, Shell Canada.

summary of the waste types of concern identified at the site and the respective disposal and treatment options employed.

Of the wastes listed in Table 3.1, only 4-5 tonnes of leaded gasoline storage tank sludge and lead contaminated material required disposal at a hazardous waste facility. All other wastes were either treated on-site, recycled or disposed at a licensed industrial landfill. The oil contaminated soils were landfarmed on-site to reduce organic concentrations to acceptable levels.

Hydrogeologic testing of the area indicated that groundwater quality on-site and off-site was similar, with the exception of some localized elevated values of certain measured parameters. These localized elevated concentrations were not of concern as all houses down-gradient of the refinery are supplied by the municipal water supply system. It was concluded that the groundwater quality both on-site and off-site was only marginally suitable as a domestic water supply. No treatment of the groundwater is planned as the MOE is satisfied that the Shell Refinery has not impaired overall groundwater quality in the area. Remediation of some parts of the Shell property is still underway. This task is scheduled for completion in fall 1988.

Future Trends

The Shell and Texaco Refineries are two of nine such facilities in the Province of Ontario. The decision to close these refineries was based on market conditions. Representatives of the industry indicated that factors which affected the closing of these two plants in particular included their location in predominantly residential areas. As an example, the Shell refinery occupied 221 hectares (547 acres) of potential residential land in Oakville. Representatives of a number of oil companies in the Province indicate that it

is unlikely that any of the remaining seven refineries in the Province will close, now that a percentage of the Provinces refining capacity has been dismantled. Industry sources commented that it is possible that one additional refinery in Canada may close in the foreseeable future, however, the location has not been announced to date.

The quantities of material actually produced as a result of these projects is small compared to other decommissioning projects, and much of the material is amenable to on-site biodegradation.

For the above reasons, decommissioning of refineries is not considered to be a likely major source of waste generation in the future.

3.3.2 MAJOR TERMINALS AND BULK STORAGE FACILITIES

Over 600 major terminals and bulk storage facilities are located throughout the Province at present. Some have been closed and decommissioned in the recent past, and consideration is being given to closing more based on a number of factors including:

- A trend towards more centralized distribution facilities, hence not as many bulk storage facilities required.
- The leases on many of the properties have expired, and the oil companies want to divest themselves of the land.

The number of bulk stations licenced in Ontario each year since 1980 is presented in Table 3.2.

Table 3.2
NUMBER OF BULK PLANTS*
LICENCED IN ONTARIO

Year	Number of Major Terminals and Bulk Plants Licenced in Ontario	Assumed Number Closed
1980	869	N/A
1981	857	12
1982	820	37
1983	782	38
1984	739	43
1985	677	62
1986	632	45
1987	603	29

* Source: Ministry of Consumer and Commercial Relations, Fuel Safety Branch Records.

Decommissioning of bulk stations is typically associated with generation of contaminated soil resulting from spills and leaks during the operational life of the facility. In addition, there may be waste oils and tank sludges that would also require treatment or disposal, prior to dismantling and removal of tanks.

The most common disposal option for the contaminated soil appears to be disposal at a municipal or private licensed landfill where it is frequently used as cover material and reportedly is a very good cover material. On-site treatment by landfarming could be considered for contaminated soils and sludges produced from this source. This consists of fertilizing and rototilling the contaminated soil to allow natural soil bacteria to biodegrade the oils and grease. Organic sludges may also be applied to the land and treated in the same manner. Contaminated soil can also be spread on land for removal of volatiles by aeration. A discussion of these treatment methods is presented in CANVIRO (1988).

There is also the possibility of localized groundwater contamination at these facilities. However, this was not required at any of the decommissioning projects identified as part of this study. If necessary, groundwater remediation at such sites would typically involve on-site treatment by activated carbon and or air stripping.

Case Study - Decommissioning of the Texaco Bulk Plant, North Bay

In June, 1987, this facility was decommissioned and 14,000 m^3 of contaminated soil and some tank bottom sludges were excavated and disposed of at the North Bay municipal landfill.

Future Trends

It is likely that additional major terminals and bulk storage facilities will be closed in the future in Ontario, as a result of consolidation of facilities and changing market conditions. Industry sources indicated that they expect the decommissioning of these facilities to continue over the next 5-10 years, but could not comment on numbers or locations of sites for confidentiality reasons. Contaminated soil is the major waste produced by this type of project. Depending on the space available at any given site, landfarming of contaminated soil could be considered. However, if space is limited, the options available are either in-situ biodegradation or removal to a licenced landfill, with the latter option being more likely, at least in the short term.

It is possible that municipal landfills may no longer accept large volumes of contaminated soil for disposal in the future, as this material takes up valuable landfill capacity. If current practice changes in this regard, alternative handling

methods would probably tend towards on-site treatment, rather than disposal at a hazardous waste facility.

3.3.3 GASOLINE STATIONS

A number of gasoline stations have closed in the Province during the last few years, and industry sources state that this trend is expected to continue with amalgamation of oil companies and streamlining of business activities. Table 3.3 indicates the decreasing numbers of licenced gasoline stations in the Province for each year since 1980.

Table 3.3

NUMBER OF GASOLINE STATIONS LICENCED IN ONTARIO

Year	Number of Gasoline Stations Licenced in Ontario	Assumed Number Closed
1980	9133	N/A
1981	8746	387
1982	8451	295
1983	8083	368
1984	8118	N/A
1985	7953	165
1986	7836	117
1987	7794	242

* Source: Ministry of Consumer and Commercial Relations, Fuel Safety Records.

Decommissioning of gasoline stations, and clean-up projects at operating gasoline stations usually involve contaminated soil associated with leaking underground storage tanks or soil contaminated from spills. This material is generally disposed of at a licenced landfill, or is spread out to aerate volatiles, depending on the source of contamination. On-site techniques such as vapour extraction are also currently used at some remedial projects. Bioremediation of

contaminated soil is also viable, and is currently being used at one project. Leaking underground storage tanks are discussed in more detail in Section 3.3.5.

3.3.4 COAL GASIFICATION SITES

Background

Former coal gasification sites received significant attention in the last two or three years, primarily as a result of the coal tar deposit discoveries in Ottawa, Chippawa Creek and Waterloo (in 1986).

An inventory of municipal coal gasification sites in the Province was carried out by Intera Technologies* for the MOE in 1987. The study has identified 41 abandoned manufactured gas plant sites in 36 different communities in Ontario. These manufactured gas plants were operated by the local municipalities and produced gas for illumination and heat in Ontario from about 1850 to the late 1950s, mostly by carbonization of coal. In addition to combustible gas, these plants produced by-products, such as tars, sludges, liquors and other gas cleaning wastes. The chemical groups of primary concern in the wastes are polynuclear aromatic hydrocarbons (PAH) and light aromatic hydrocarbons. Several compounds in these chemical groups that are contained in tars have been documented as cancer causing. Adverse human health effects from exposure to these chemicals is primarily by inhalation and dermal contact.

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* Intera Technologies Ltd., "Inventory of Coal Gasification Plant Waste Sites in Ontario", 1987.

An inventory* of major industrial facilities producing coal tar wastes was carried out recently and identified a further 44 sites in 24 communities.

In general, clean-up of these sites would be necessary where there is evidence of ground or surface water contamination resulting from the coal gasification wastes, contaminated soils or exposed areas of the waste, or a detectable odour caused by coal tar vapours. The requirement for any clean-up activities is generally determined by the Regional MOE offices.

Waste Disposal/Treatment Options

The two common coal tar management options employed in Ontario to date have been disposal at a hazardous waste management facility (eg. Tricil) and disposal at a licensed landfill.

Criteria levels to classify coal tar contaminated materials as hazardous were defined by the MOE for the Waterloo coal tar site clean-up project. The MOE guidelines stipulate that all solid materials (eg. contaminated soil, tar sludges) must be subjected to the Regulation 309 leachate extraction test, and the leachate analyzed for benzo(a)pyrene. The material is classified as hazardous if the benzo(a)pyrene concentration in the leachate exceeds 1 ppb. Contaminated liquid wastes are classified as hazardous if benzo(a)pyrene concentrations exceed 1 ppb. Wastes classified as hazardous

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* Intera Technologies Ltd., "Inventory of Industrial Sites Producing or Using Coal Tar and Related Tars in Ontario", Draft Report, July 1988.

must be disposed of at a hazardous waste management facility (eg. Tricil); however, the lightly contaminated material (non-hazardous) may be disposed of at a licensed landfill.

On-site treatment of contaminated water has been successfully employed at the abandoned coal manufactured gas plant situated at the present location of Lees Avenue Station in Ottawa. Contaminated water was filtered for particulates, treated by granular activated carbon (GAC) and discharged to the sanitary sewer. Tarry substances were separated in a skimmer and sent off-site to a hazardous waste management facility for incineration; the separated contaminated water was routed through a GAC adsorber.

Incineration methods for on-site treatment of solid coal tar wastes are not yet available in Ontario. On-site biodegradation of coal tar contaminated soil has been demonstrated in the U.S. by Environmental Solutions of Louisianna but has not been used in Ontario to date. A discussion of potential on-site treatment processes for coal tar deposits, sludges and contaminated soil is provided in CANVIRO (1988).

Case Study, Waterloo City Hall Clean-up

The remains of a coal gasification plant and associated wastes were uncovered during construction activities in July 1986 to redevelop the site for the new Waterloo City Hall, located in downtown Waterloo, Ontario. Residual wastes present in the subsurface were primarily coal tar contaminated soil and construction debris. The site is located within 120 meters of municipal wells for the Regional Municipality of Waterloo, and overlayed the water supply aquifer as well as being located adjacent to a creek.

The potential to contaminate the water supply and concerns over adverse environmental impacts on the creek together with probable delays in building construction necessitated the expeditious removal of the wastes. However, the non-existence of regulatory policy for this material at the time and a lack of information regarding the chemical properties of the wastes complicated a rapid clean-up. As a consequence, wastes were excavated and stored on-site on an interim basis and were characterized through chemical analysis of both bulk soil samples and leachate generated in an acetic acid leach test. Chemical analyses were performed primarily for polynuclear aromatic compounds which are the main constituents present in coal tar, (coal tar is the key waste product of concern in the manufacture of coal gas). A selected number of waste and leachate samples were also analyzed for phenols, oil and grease, cyanide and trace metals.

The criteria developed for waste classification by provincial regulatory authorities was based on the concentration of Benzo(a)pyrene, a known carcinogen, in leachate produced in laboratory leach tests and is as follows:

Leachate B(a)P	Classification	Disposal Method
10-100 ppt	non-registrable, non-hazardous	Licenced landfill
100-1000 ppt	registrable non-hazardous	Licenced landfill
>1000 ppt (>1 ppb)	hazardous (leachate toxic)	Hazardous waste facility

The wastes highly contaminated with coal tar were designated as "Hazardous" and 3300 tonnes of waste were subsequently disposed at a hazardous waste facility. These wastes were segregated onsite using visual evidence of coal tar as

classification criteria. The remaining 16,000 tonnes of contaminated non-hazardous wastes were disposed at the municipal landfill.

A parallel hydrogeologic investigation, specific to the dense immiscible properties of the coal tar, was undertaken to identify the fate and extent of contamination in the sub-surface. These studies are still on-going.

Future Trends

A concerted effort has been expended by the Ontario MOE to identify all former and existing coal gasification sites in the Province, both municipal and industrial. The industrial sources of coal tar wastes include wood preservers, coke ovens, wood distillation, roofing felt and tar products and industrial manufactured gas plants.

It was originally suspected that remedial work might be required at up to one third of the sites identified in the municipal inventory (Intera Technologies, April 1987). However, a number of these sites are being studied during the next few years, to more accurately define any problems at specific locations. Treatment or removal of material from these sites may not be essential unless a clear impact is identified at the property boundary. The MOE has targetted $1.7 million from the Security Fund to study these sites over the next three years. At this time it appears that site owners and municipalities will be responsible for clean-up costs. Information was not available on remedial work required at the industrial coal tar sites at the time of writing.

On-site treatment technologies have been tested at coal tar clean-up projects in the U.S., by Environmental Solutions of Louisianna and it is also likely that if proven this technology would be considered at Ontario sites in the future.

A detailed discussion of this topic is provided in CANVIRO (1988).

3.3.5 LEAKING UNDERGROUND STORAGE TANKS (LUSTS)

The problem of leaking underground storage tanks (LUSTS) has been identified as a significant one in both Canada and the U.S. in recent years. It is worth noting that $500 million U.S. of the SARA funding has been dedicated to developing a comprehensive regulatory program on underground storage tanks in the U.S. On a present value basis, the USEPA estimates that the costs for clean-up of underground tanks will approach $60 billion U.S. over the next 30 years (Higgins, 1987).

Underground storage tanks are used by gas stations and many industries for storage of a variety of chemical and petrochemical products. The problem with these installations is that there are a number of ways in which a leak can occur eg. faulty connection, pinholes in tank walls or floor, and depending on the level of surveillance of tank liquid levels, it can take some time before a leak is detected. By this time, the leaked product may have migrated and contaminated groundwater, and soil. Environmental damage may be significant depending on soil conditions, and the length of time the leak went undetected.

The typical approach to leaking underground storage tank clean-ups in Ontario includes excavation and removal of contaminated soil. In-situ methods such as vapour extraction to remove volatiles from contaminated soil, aeration of soil for volatilization of contaminants, pumping for product recovery, and also in-situ biotreatment are also practiced. In the U.S. the approach varies depending on site size. For smaller projects, such as spills or small leaks at gas stations, clean-up usually consists of excavation and

off-site disposal of contaminated soils, product recovery, groundwater treatment by activated carbon adsorbtion and/or air stripping, and spreading of contaminated soils to volatilize the contaminants. For larger projects, in-situ and on-site treatment have proven cost effective in a number of U.S. projects. These include on-site soil incineration, soil vapour extraction, in-situ steam stripping, soil flushing and bioreclamation. The applicability of some of these technologies has not been tested in Ontario to date, but it is expected that on-site treatment will increase in the coming years.

Leaking underground storage tanks (LUSTS) are discovered during decommissioning projects, and form part of a number of clean-up projects. It was not possible to develop an estimate of the total number of LUSTS in the Province as part of this study, as adequate information on the total number of tanks in Ontario was not available, however, some preliminary ranges are included below.

Environment Canada estimated that there were 10,000 leaking underground storage tanks (LUSTS) of an estimated total of 200,000 tanks in the Canada in 1986. A breakdown of the number of these in Ontario was not available.

There were 7,794 licenced service stations in Ontario in 1987, each containing an average of four underground storage tanks*. This sector of the economy alone accounts for approximately 31,000 underground storage tanks. Assuming that 5%** of these are leaking, this results in up to 1550

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* Reference - Environment Canada, January-March 1988 Leaking Underground Storage Tank Newsletter

** Environment Canada Preliminary Estimate.

LUSTS in the Province at service stations alone. The above estimate does not include tanks at "private outlets", such as fuel storage tanks for taxi fleets, police cars etc. or other non-licenced establishments.

A government industry task force was convened to develop an Environmental Code of Practice for Underground Storage Tanks Containing Petroleum Products. This work is nearing completion, and when implemented should provide greater control over underground storage tanks in general. Under the Gasoline Handling Code, all pre-1974 steel tanks must be replaced by 1991. It is expected that significant numbers of tanks will be replaced as a result of this regulation, and many leaking tanks resulting in contaminated soil may be discovered as a result of this program. Obviously clean-up of areas discovered during this process will be required. As this activity should be completed by 1992, it has not been given significant attention during this study.

Under existing regulations if underground tanks are out of use for 5 years, and the owner is uncertain as to whether they will be used again it is a legal requirement that they be removed. This requirement may be changed to 2 years in the future*. This will increase the number of tanks being removed from below ground, and will potentially increase the volumes of contaminated material discovered. Again, this would be a short term increase, related to changing regulations.

Gasoline and petroleum products are probably the materials most frequently stored in underground tanks, although many other chemicals are also stored in this manner. No official

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* MCCR Fuel Safety Branch, Personal communication

records of the total number of underground storage tanks for all material in the Province could be obtained for this study.

The State of New Jersey has recently created a Bureau of Underground Storage Tanks. Up to August 1987, 25,000 facilities registered 60,000 tanks in this program. State officials estimate that a total of 50,000 facilities will register 125,000 tanks by the time the program is completed. Of these, one third or 40,000 tanks are estimated to require some degree of corrective action. State officials further estimate that 5%, or 2-3,000 tanks will require corrective action annually**. As New Jersey is similar in population and industrial base to Ontario, the above numbers are an indication of how many USTS could be in this Province. If even 5% of the total number of tanks were leaking, this would result in 6,000 potential clean-up projects, of varying size, depending on soil conditions.

Future Trends

It is expected that clean-up projects related to leaking underground storage tanks will continue for the foreseeable future as there are likely many older tanks still in place in the Province which may not possess the integrity of newer tanks which come under more rigorous regulations. LUSTS will also likely continue to be discovered as part of decommissioning projects. On-site treatment may be considered in cases where it is economically advantageous over off-site removal.

** Reference - New Jersey DEP Comprehensive Management Plan 1988 - 1992

3.3.6 LAGOONS

Many lagoons are located throughout the Province, containing a variety of materials related to industrial operations. These materials range from sludges produced by plating or wastewater treatment operations, to miscellaneous chemicals stored on-site for a variety of reasons.

Decommissioning of lagoons occurs when a plant closes. Clean-up of old lagoons usually occurs when an environmental problem is identified ie. contamination resulting from the lagoon is discovered in ground and/or surface water. An inventory of active and abandoned lagoons in the Province of Ontario has not been compiled to date; however, unconfirmed reports indicate that 100 to 300 of these facilities, many containing 2,000 - 12,000 tonnes of liquids and sludges, could require some form of attention during the coming years. This estimate can not be confirmed in the absence of a systematic inventory but indicates a potentially significant source of decommissioning and clean-up activity in the future.

Decommissioning and/or clean-up of these facilities in the past usually required excavation of the material, and disposal at either a hazardous waste facility such as Tricil, or a licenced landfill, depending on the material, the moisture content, and the leachate characteristics. If the moisture content of the lagoon contents is high, the contents can be dewatered prior to disposal, to decrease the quantity of material to be handled. This can be carried out by a mobile filter press. The filtrate can be treated on or off-site, depending on its characteristics, and the volume involved. The filter cake would be disposed of at a hazardous waste facility. A recently completed project involved on-site solidification of inorganic plating wastes contained

in industrial lagoons. This project indicates promise for increased on-site treatment of lagoon wastes in Ontario in the future. Bioremediation and/or landfarming of organic sludges is also feasible.

Municipal lagoons were studied by the MOE in 1979-1980 to determine if these presented a problem. The study concluded that municipal lagoons were non-hazardous, and that any concerns were related to bacterial contamination.

Future Trends

It is likely that clean-up and decommissioning of lagoons will continue for some time to come. On-site treatment of both inorganic and organic wastes may increase in the future.

3.3.7 OLD LANDFILL SITES

The MOE carried out an extensive study in 1979 to identify all abandoned landfill sites in the Province. A total of 1,300 - 1,500 sites were identified at that time which had been closed prior to 1971, and did not have a Certificate of Approval. Further studies at that time concluded that only 3 or 4 of these sites were a potential problem, and these are under investigation at present (Ref. Joe Petoia, MOE).

Since 1983 the MOE has developed a more comprehensive inventory of both open and closed landfills in the Province. A total of 1,395 open and 2,455 closed landfills are included in the inventory. Of these, 61 active and 38 closed Class A1 and A2 sites, which are known to have received, or are permitted to receive liquid industrial or hazardous waste, were identified as of June 1988. (Ref. Ulo Sibul, MOE Waste Management Branch). It is not unreasonable to assume that some of these may become problem sites in the future.

On-going problems at operating landfills are identified from time to time. These are generally related to gas production, leachate quality and/or groundwater contamination. The general approach to resolving problems at existing landfills is to contain and treat or dispose of the leachate produced. Removal of material is not generally considered, except in a case such as the Gloucester Landfill in Ottawa, where the area of serious contamination was known (Maclaren Engineers, 1987). Even in this case, a relatively small quantity (approximately 1800 tonnes) of material was actually excavated and hauled to a hazardous waste facility.

It is likely that identification of problems at existing and closed landfills will continue on an on-going basis. The Upper Ottawa St. and Pauze Landfills are examples of this.

The approach to remediation however, is unlikely to involve removal of material off-site, as in many cases the area where the hazardous material was deposited is not known, or hazardous materials are suspected of being located throughout a site. Because of the large volumes involved, particularly where industrial or hazardous waste is co-disposed with municipal garbage, removal of all material from a closed or even an operating landfill is not a practical or economically viable option. Remediation of problem landfill sites is more likely to involve leachate containment and treatment. In some cases, groundwater treatment may also be required. Residuals from the on-site ground water or leachate treatment system would likely require off-site disposal. A more detailed discussion of leachate treatment technologies is presented in Xenon (1988).

A set of criteria are currently being developed to determine which sites should be placed on the Canadian National Superfund list which will be developed as part of the CCREM Hazardous Waste Action Plan. It is possible that more

sites will be identified in Ontario as a result of this exercise. However this task of developing an inventory of "Superfund" type sites for Ontario has not begun, and will not be completed for some time.

3.3.8 PCB CONTAMINATED SITES

PCB's have received a lot of attention in recent years because of concerns regarding the suspected potential carcinogenic nature of the material. The major problem associated with PCB clean-up projects is that there are limited facilities in Ontario which are licenced to treat PCB's. Four firms have approval to treat low level (<10,000 ppm) PCB containing mineral oils. High level PCB liquid wastes are usually stored at an MOE approved storage facility for possible treatment and disposal at a future time.

No treatment methods have been approved for PCB contaminated solids (e.g. soils), and at present these wastes are stored in facilities throughout the Province. If these wastes contain greater than 50 ppm PCB, they are considered a PCB waste and fall under Regulation 11/82. If they contain less than 50 ppm PCB, they are covered in Regulation 309. If the waste produces a leachate with less than 0.3 ppm PCB (i.e. 100 times the Provincial Drinking Water Objective) it is classified as non-hazardous and can be disposed at a licenced landfill, if they are willing to accept the material. If the leachate contains greater than 0.3 ppm PCB, it is considered hazardous.

Some large-scale PCB clean-up activities have been carried out in the Province recently. These include the Pottersburg Creek clean-up in London, Ontario, where PCB contamination migrated downstream along the banks and bed of Pottersburg Creek. The clean-up project followed the discovery of elevated PCB levels in fish samples by MOE. Soil with 1-20

ppm PCB's was capped in place. Any soil containing PCB values in excess of 20 ppm was excavated and stored in an on-site vault.

The Clear Lake incident,near Ottawa, is another well known PCB clean-up project. In this case, PCB contaminated oil had inadvertently been used for dust control. The contamination was discovered from fish analyses carried out by the MOE. Asphalt was placed over the area of highest PCB contamination. Approximately 12,000 tonnes of PCB contaminated granular "B" road bed material were removed off-site and mixed with cementatious material and kiln dust and covered over by a 2 m depth of soil. The PCB molecules are considered to be immobilized by this process.

A truck carrying PCB contaminated material developed a leak, and deposited PCB contaminated material on an estimated 9.5 km of Hwy No. 17 near Kenora in 1985. Absorbent material was applied to the contaminated areas and 230 drums were filled with PCB contaminated solids. All recovered materials were stored in a vault located near the site at an Ontario Hydro yard. Consideration was given to excavating the section of highway where it was suspected that the contamination occurred, however, it was decided to asphalt over the area instead.

Future Trends

The above discussion illustrates the diverse nature of PCB clean-up projects. PCB use in the Province ceased in the late 1970's, hence new PCB sources have not been introduced to the marketplace for almost 10 years. Problems are related to units in service or to poor waste management practices in the past.

Many decommissioning projects (eg. Mines, Department of National Defence facilities etc.) involve relatively small (less than 5 tonnes) quantities of PCB materials. It is expected that PCB contaminated material will continue to be produced as plants using capacitors and transformers containing PCB's close down and are decommissioned. Decontamination of PCB containing liquids covered in the Regulation 11/82 database is dealt with in a separate report in preparation by M.M. Dillon at the time of writing. This report addresses PCB contaminated soils and solids only.

Problems related to past practice (eg. Pottersburg Creek) will likely continue to be discovered, but at a slower rate, assuming that major potential producers of such sites ie. industries involved in the manufacture of electrical transformers and capacitors, have already identified any major clean-up projects. These projects typically involve handling of PCB contaminated soils, which is addressed in this report.

Because of industry concern regarding the storage of PCB's, and the fact that a waste disposal option is not available in the Province for PCB contaminated soils, and high level PCB liquid wastes at present, a number of companies may try to obtain approval for a variety of on-site treatment systems. Examples of these technologies include rotary kiln incineration (by ENSCO) and Shiro infrared technologies as proposed by Sanexen, of Burlington. High level PCB fluid decontamination technologies and microbial PCB degradation technologies are also being considered for future use. To date none of these systems has been approved for use in Ontario. There are four approved mobile processes for decontamination of PCB containing mineral oils (<10,000 ppm) in Ontario at this time.

Development of the Smithville PCB clean-up project may provide some indication of public response to on-site treatment of PCB's. The Smithville site was owned by a business which collected PCB contaminated oils. The site contains PCB contaminated soils, oils and groundwater. The contract for the second phase of the clean-up project has recently been awarded to ENSCO. A certificate of approval must be obtained for ENSCO to operate its mobile incineration system at the Smithville site. A public hearing will be required as part of the process. This project will provide insight into public response to this type of system.

3.3.9 MINE SITES

Under the Mining Act, each operating mine in Ontario must have a close-out plan which leaves the environment in acceptable condition. The general approach to decommissioning of mines is to salvage as much equipment as possible from the underground operations, for sale or use at other facilities. The mill equipment is cleaned for sale or use at other facilities. Any milling chemicals left over at the end of the operation are either returned to suppliers or sold to other facilities. Mill buildings and other buildings at the site are demolished; hydro lines, pipelines etc. are dismantled and the rubble usually landfilled on-site. Any PCB containing capacitors or transformers from underground or the site power system are normally shipped off-site for storage elsewhere. A recent mine decommissioning project in Ontario generated a total of approximately 5 tonnes of PCB waste, which is stored on-site at present.

The decommissioned mine and mill site and tailings area is then regraded to promote acceptable drainage when abandoned. The major concern with decommissioned mine sites is appropriate handling of the massive volumes of tailings generated

during the operating life of the mine. These are normally deposited in lake beds, and the decant treated prior to discharge to a receiving stream. When the mine is closed out the tailings area is normally regraded to promote good drainage. The tailings, which are coarse and fine sand-sized particles, are covered over with soil (if available) to minimize erosion potential. A vegetative cover is established on top of the cover material if at all possible, to further minimize erosion. Hence, once abandoned, the former mine site should require no further attention.

From the above brief description it is evident that decommissioning of mine sites, which will be an on-going activity because of market changes and depletion of ore bodies, does not produce any significant quantities of waste material which require disposal off-site. Because of the remote location of these facilities, shipment of any material off-site is minimized where at all possible.

3.3.10 MISCELLANEOUS INDUSTRIAL SITES

Clean-up

Clean-up of miscellaneous industrial sites can be required at any given time because of a variety of circumstances. In some cases the triggering mechanism is contamination observed in either surface water or groundwater which is then traced back to an industrial facility and can be a result of:

- Leaking underground storage tanks
- Old lagoons
- Contaminated soil from previous practices
- Poor storage facilities
- Poor spill control facilities or
- Numerous other causes

These activities are expected to continue and possibly increase in the future, with more environmental surveillance by the MOE. Wastes produced by these projects could include contaminated soils, lagoon wastes, sludges etc. Groundwater contamination is often remediated by some form of on-site treatment system. In most cases at present the offending materials are removed off-site. However, depending on site location and the nature of the contamination, on-site treatment may be considered more as it develops in the future.

Industry's increased awareness of environmental issues, brought on at least in part by the revisions to Regulation 309 has prompted consideration of clean-up of a number of properties where pressure has not yet been exerted by MOE officials. This trend is expected to continue for many years to come, as the results of poor waste management practice in the past are remediated.

The requirements to clean-up a property prior to transfer of ownership is becoming a common clause in property transactions, and will result in an increasing number of clean-up projects in the future. The "ECRA" law (described in Appendix "D") has been in place in New Jersey since 1984 and has resulted in hundreds of clean-up projects varying in size from a few hundreds to many millions of dollars. The awareness of the liability associated with a polluted property has increased significantly in recent years, resulting in increased caution with property transactions.

Decommissioning

Decommissioning of industrial sites is expected to continue and possibly increase, as older facilities close down, and industry modernizes. Political changes such as Free Trade with the U.S. could have a major impact on the number of

industrial facilities which will close and require decommissioning in the future. The increased pressure to develop urban areas may encourage industries to relocate away from expensive downtown properties, increasing the number of decommissioning projects carried out. Wastes typically produced by these activities include lagoon sludges, contaminated soils and some process wastes left over at the end of operation. On-site treatment could be considered where large volumes of material are involved, or where the soil contaminants are amenable to biodegradation or thermal destruction. Decisions on these issues would also be influenced by planned future land use.

Residuals from on-site treatment of the contaminated groundwater could also be produced, depending on the treatment technologies involved. These residuals are typically disposed off-site.

3.3.11 CONSTRUCTION - REDEVELOPMENT SITES

Pressure on downtown urban land for alternative development may encourage industries to relocate to suburban areas, and decommission former properties for sale to developers as valuable development property. Also, large urban properties currently occupied by older industrial facilities may be redeveloped for a different land use following closure of these facilities. An example of this trend is seen in Southern Ontario where the Goodyear Plant on Lakeshore Boulevard in Toronto's west end has been decommissioned and sold to a developer. This trend results in a number of clean-up/decommissioning projects, each producing some wastes described in earlier sections of the report.

The development of downtown properties in former industrialized areas for a higher use has resulted in discoveries of

contaminated material, which is usually remediated immediately in order not to cause any expensive construction delays. As pressure on the downtown areas of major urban centres increases, it is expected that this trend will continue. A number of examples of this trend were identified during this study, including discovery of coal tar deposits when excavation began for construction of the new Waterloo City Hall. Other examples include the former Lax property in Hamilton, which is being cleaned up for development of a public park, and the former CN property in downtown Toronto, where some contaminated soil was encountered during excavation at the site of the new Domed Stadium.

Chapter 4
STUDY FINDINGS

This chapter addresses factors affecting site clean-up and decommissioning activity in the future. The level of clean-up activity and the funds available for this activity in some U.S. jurisdictions are discussed. The implications of developing on-site treatment technologies are addressed. The identified quantities of material produced by site clean-up and decommissioning activities in Ontario in 1986 and 1987, and what percentage of these wastes were disposed at licenced landfills and at hazardous waste facilities are presented. The impacts of all of the above factors on future quantities of material produced by site clean-up and decommissioning activities in Ontario are discussed, and preliminary first order estimates of future quantities of waste from these sources are presented.

4.1 EXISTING AND FUTURE LEGISLATION IN ONTARIO

Site clean-up and decommissioning activities are driven by regulatory, economic and liability concerns. Changes in the level of activity are dependent on regulations in place at any given time. The high level of activity experienced in the U.S. in this area has been as a result of:

1) New regulations, such as CERCLA, SARA, RCRA, and numerous state regulations discussed in Section 4.2.

2) Concern on the part of industry regarding liability and cost of future clean-up.

3) Regulations which promoted the development of inventories of problem sites, and therefore quantified the problem.

4) The availability of funding for clean-up activities and studies.

The situation in Ontario is quite different from the U.S., and direct parallels can not easily be drawn. Ontario does not have the following items in place at this time:

- "Superfund" legislation or funding
- A comprehensive inventory of all problem sites
- A large tax revenue dedicated to funding clean-up activities, or
- Legislation forcing clean-up of sites prior to sale of property.

Existing legislation in Ontario which affects site clean-up and decommissioning includes the Environmental Protection Act, the Ontario Water Resources Act, and some environmentally oriented municipal by-laws, as discussed in Section 3.2. Future legislation and regulations which may affect the level of site clean-up and decommissioning in the Province includes;

- Potential changes to the Environmental Protection Act

- Development of Ontario Guidelines for Decommissioning of Industrial Sites (1988)

- Development of National Decommissioning Guidelines (1988-1989)

Depending on the levels set in these guidelines for determining what is clean, particularly with respect to contaminated soils, the quantities of material which must be treated or removed off-site could increase.

The final text of these guidelines was not available at the time of writing, hence it is not possible to comment further on this issue until the text becomes available.

Development of a Canadian Superfund, which is being considered at this time, and is being evaluated as part of the CCREM Hazardous Waste Action Plan, could have a significant impact on the level of clean-up activity in Ontario. The actual text of the Canadian Superfund legislation has not been developed, and will not be available for some time, hence further comment is not possible at this time. It is probably safe to assume that clean-up activity in the Province would increase as a result of this initiative.

4.2 CURRENT LEGISLATION AND LEVEL OF CLEAN-UP ACTIVITY IN U.S. JURISDICTIONS

A number of legislative initiatives taken in the U.S. are described in Appendix D to this report, and should be referred to in conjunction with the following discussion. It is possible that similar trends may develop in Ontario in the future. The quantity of hazardous wastes potentially generated by these programs is addressed in section 4.5.

4.2.1 FEDERAL SUPERFUND

CERCLA, enacted in 1980, included a mandate to develop a National Priorities List (NPL) of hazardous waste sites requiring remedial action. The list was to include at least 400 sites. To be considered for the NPL a site must rate a score of at least 28.5 points on the Hazard Ranking System (HRS).

The original NPL, published in 1982, contained 418 sites. Of these, 65 were in the State of New Jersey, and four states had no sites at all. In the intervening years,

additional sites have been nominated for the NPL. By 1984 it contained 538 sites,and it currently contains 802 sites. A further 149 sites are proposed for the list. Table 4.1 shows the number of sites on the NPL each year since its inception, and Table 4.2 shows the NPL status as of June 1987. The EPA estimates that the NPL could ultimately contain as many as 2,000 sites (Reference: OTA "Superfund Strategy", April 1985). The Office of Technology Assessment considers this an underestimate and predicts that the NPL could ultimately contain as many as 10,000 sites. A lengthy discussion of projections is provided in OTA (1985).

Table 4.1

NUMBER OF SITES ON THE SUPERFUND NATIONAL PRIORITY LIST (1982 - 1987)

Year	Number of Sites
1982	418
1983	406
1984	538
1985	541
1986	711
1987	802

Reference: Personal communication, S. Crystal EPA Site Evaluation Office

Actual remedial work and clean-up at NPL sites has been minimal, and most of the CERCLA funding was directed to studying problem sites. Clean-ups were only carried out at a handful of sites which presented an immediate hazard to human health or the environment.

Under Section 107 of CERCLA past or present owners and operators of sites, and generators and transporters who contributed hazardous substances to sites are liable for all clean-up costs. Table 4.3 shows the status of private party

Table 4.2
STATUS OF SUPERFUND NATIONAL PRIORITIES
LIST, JULY 1987

State	Final	Proposed	Total
AL	9	1	10
AK			0
AZ	6	3	9
AR	9	1	10
CA	48	15	63
CO	13	2	15
CT	7	1	8
DE	12	6	18
FL	34	5	39
GA	4	3	7
HI	0	6	6
ID	4	0	4
IL	17	10	27
IN	24	5	29
IA	7	6	13
KS	7	1	8
KY	10	0	10
LA	6	2	8
ME	6	1	7
MD	7	2	9
MA	21	0	21
MI	58	11	69
MN	40	0	40
MS	2	0	2
MO	14	5	19
MT	8	1	9
NE	3	2	5
NV			0
NH	13	0	13
NJ	96	4	100
NM	2	0	2
NY	63	4	67
NC	9	2	11
ND	1	0	1
OH	28	2	30
OK	6	0	6
OR	5	1	6
PA	61	19	80
RI	8	0	8
SC	12	3	15
SD	1	0	1
TN	9	1	10
TX	22	4	26
UT	5	5	10
VT	2	0	2
VA	11	8	19
WA	23	5	28
WV	5	1	6
WI	32	1	33
WY	1	0	1
Total	802	149	

Reference: Personal Communication, S. Crystal EPA Site Evaluation Office

involvement in Superfund activities up to June 1985. At that time, clean-up had been completed at 21 NPL sites.

The growth of the NPL from 400 to 800 sites in five years serves to illustrate how the magnitude of the identified problem increased as more funds become available for investigation and remediation.

Table 4.3
STATUS OF PRIVATE PARTY SETTLEMENTS RELATED TO SUPERFUND NPL SITES

Purpose	No. of Settlement	Total Value $U.S. Million	Amount Spent to Nov. 1985 $U.S. Million
Study	30	26.1	8.9
Partial Clean-up	19	51	29.1
Final Clean-up	21	282.5	61.6
Other - (Site access, ground-water monitoring etc.)	3	1.1	1.1
Total	73	360.8	100.7

Reference: General Accounting Office, Washington, D.C., "Hazardous Waste: Status of Private Party Efforts to Clean up Hazardous Waste Sites", December 1985.

4.2.2 NEW YORK STATE

New York State initiated an informal study on the hazardous waste problem in the state in 1974. In 1978, the Love Canal discovery prompted a study on possible hazardous waste sites in the Erie and Niagara Counties. A total of 215 sites were

identified in this area, 36 of which were known to have received large volumes of hazardous waste. This discovery (August 1978) was followed by the 1979 Abandoned Sites Act, under which a State inventory of inactive sites was developed. The first registry of Inactive Hazardous Waste Dump Sites, published in June 1980, listed 680 sites. By June 1984 the Registry contained 895 sites. An industrial survey carried out in 1984, to which 60% of 14,000 surveyed industries responded, identified an additional potential 449 sites. These were investigated further to determine which sites should be on the State Registry. By October 1987 the State Registry contained 1231 sites, and it is ultimately expected to contain 1,400 sites.

The status of the State sites at different times is shown on Table 4.4. As of October 31, 1987, one (1) Federal Superfund Site, ten (10) State Superfund Sites, and 73 Responsible Party Sites have been remediated. Remedial programs were completed or in progress at 309 Sites, 222 funded by responsible parties, 44 by Federal Superfund, 35 by State funding and 8 by local authorities.

Most of the clean-up efforts to date have been by private parties. Reason for this action is that it is less expensive for industry to clean-up sites themselves, than to have the project carried out by government forces who would recover the costs from the industries at a later time. Under SARA, it is possible for the EPA to sue a company for treble the clean-up costs at a site for which they are responsible. Hence industry elect to maintain control over clean-up activities and costs.

A total of 107 New York State sites have been nominated for the Federal Superfund National Priorities List. Of this number, 29 were on the original Superfund NPL, published in 1980. A further 29 nominations have been rejected. A total

Table 4.4
STATUS OF NEW YORK STATE
INACTIVE HAZARDOUS WASTE SITES REMEDIAL PLAN

New York State Site Class Number	Description	Number of Sites June 1984	Number of Sites Oct. 1987
1	Immediate danger to human health or environment	0	0
2	Significant threat to public health or environment	144	285
2a	Suspected of being Class 2 sites - additional data required.	554	614
3	Known to contain hazardous waste - no problems identified	89	63
4	Closed in approved manner. Monitored to confirm no problem	96	54
5	Completely remediated no further monitoring required.	12	
	Delisted no action required	-	185**
Total Number of Sites*		895	1231

* Total number of sites was 680 in June 1980.
** Most of these sites were originally class 4 or 5, ie. a major problem was not suspected.

Reference: "New York State Inactive Hazardous Waste Site Remedial Plan Update and Status Report", New York State Department of Environmental Conservation, October 1987.

of 57 New York State sites are now on the NPL, an additional 10 are proposed for the NPL, and an additional 8 sites were nominated in fiscal year 1986 - 1987.

The State plans to clean-up an estimated 500 hazardous waste sites by the year 2000, and has implemented the 1986 Environmental Quality Bond Act to generate the $1.4 billion U.S. required for this work. An estimated 25% of the 500 sites are municipal landfills.

Remedial project starts planned for the next 3 years are shown on Table 4.5 which indicates that most of the activity in New York State is at responsible party sites. Also, construction projects which actually generate waste volumes will start at an average rate of 32 projects per year over the next 3 years. Detailed projections are not available beyond 1990, however in the years 1990 - 2000, a further 370 construction projects must be carried out to meet the state objective of clean-up of 500 sites by the year 2000. This translates to an average of 37 construction starts per year, however firm schedules have not been developed to date.

Table 4.5
PLANNED REMEDIAL PROJECT STARTS
NEW YORK STATE

Fiscal Year	Remedial Project Starts	Construction Project Starts
1986 - 1987	125	28
1987 - 1988	110	16
1988 - 1989	132	39
1989 - 1990	139	47
Total	506	130**

** 95 Responsible Party,
22 Federal Superfund,
13 State Superfund

Reference: "New York State Inactive Hazardous Waste Site Remedial Plan Update and Status Report", New York State Department of Environmental Conservation, October 1987.

Revenues available for the Hazardous Waste Remedial Fund are summarized on Table 4.6. The increase in revenue in 1986 is as a result of enactment of the Environmental Quality Bond Act.

Table 4.6
NEW YORK STATE HAZARDOUS WASTE REMEDIAL FUND
SUMMARY OF REVENUES

Year	Revenue ($US)
1982 - 1983	$ 1,223,991
1983 - 1984	3,843,846
1984 - 1985	4,238,354
1985 - 1986	20,050,933
1986 - 1987	26,444,037

Reference: "New York State Inactive Hazardous Waste Site Remedial Plan Update and Status Report", New York State Department of Environmental Conservation, October 1987.

4.2.3 NEW JERSEY

In recognition of the fact that hazardous waste disposal practices had been poorly regulated in the past, the State of New Jersey embarked on developing an inventory of problem sites in the State in the 1970's. When Superfund was enacted in 1980, New Jersey had already developed a comprehensive inventory of sites, 65 of which made their way on to the first NPL. Today, 97 of the 802 NPL sites are in New Jersey.

The current status of NPL, and Publicly and Privately funded sites in the State is presented in Table 4.7.

Table 4.7

NEW JERSEY REMEDIAL PROJECTS STATUS*

OCTOBER 1987

PUBLICLY FUNDED PROGRAM

RI/FS	FY'87 STARTS	FY'87 UNDERWAY	COMPLETED TO DATE
NPL	5	44	29
NON-NPL	3	10	2
DESIGN			
NPL	16	7	14
NON-NPL	0	0	0
CONSTRUCTION			
NPL	5	8	26
NON-NPL	2	7	5

PRIVATELY FUNDED PROGRAM

RI/FS	FY'87 STARTS	FY'87 UNDERWAY	COMPLETED TO DATE
NPL	4	29	11
NON-NPL	8	41	26
DESIGN			
NPL	3	7	10
NON-NPL	8	6	10
CONSTRUCTION			
NPL	2	9	27
NON-NPL	2	8	30

PROJECTS COMPLETED TO DATE: 190

PROJECTS UNDERWAY: 234

* New Jersey Department of Environmental Protection Comprehensive Management Plan, 1988-1992, prepared by the Division of Hazardous Waste Management, October 1987.

ECRA (described in Appendix "D") is New Jersey's most innovative legislation, and has prompted significant clean-up activity in the State.

When ECRA was established in 1984, it was staffed with five employees and it was estimated that 95 cases per year would be received. One hundred and sixty four cases were received in the first six months, an estimated 1200 cases will be received in 1988 fiscal year, and it is projected that the incoming cases will stabilize in the 1990s at 1300 per year.

When established, the ECRA Department was allocated a budget of $400,000 U.S. per year. The current budget of $2,900,000 U.S. is designed to support a staff of 104 employees to run the program.

During the period from January 1, 1984, to June 30, 1987, 3,027 cases were opened of which 1,574 cases were resolved. Private parties have spent over $10 million U.S. to complete approximately 400 documented cleanups. Cleanups have ranged from a $250 U.S. battery acid spill to the completion of a $3 million cleanup at the U.S. Steel-Wire Rope Division of Mercer County. At the close of the 1987 fiscal year, 54 cleanups were underway in accordance with approved Cleanup Plans, estimated to cost $30 million U.S. to fully implement. Major clean-up plans under ECRA include the Texaco Eagle Point Refinery, estimated to cost $3.6 million U.S., the Ford, Mahwah, site estimated to cost $4.3 million U.S., and the Fisher Scientific site in Fairlawn Borough estimated to cost $5 million U.S. to complete (ECRA 1987 Annual Report).

The program has approved 1,263 Negative Declarations ensuring that the property is free of environmental concerns. There were 374 remedial actions performed by ECRA subject parties pursuant to the approval of a Negative Declaration.

To date, approximately $480 million U.S. has been obtained in cleanup commitments by responsible parties. In comparison, the authorized Federal Superfund program began the Federal 1988 fiscal year by committing $400 million U.S. to aid cleanups nationwide. Of the total collected financial assurance, $450 million was obtained pursuant to the execution of Administrative Consent Orders (ACO), while subject parties posted $30 million in accordance with approved Cleanup Plans (Reference: ECRA 1987 Annual Report).

An Administrative Consent Order (ACO) allows transactions to proceed prior to completing all ECRA's site review requirements. Parties that enter into an ECRA ACO are also required to post financial assurances to guarantee the availability of private funds for non-compliance clean-up work.

Two major legal challenges were resolved in favor of ECRA. In October 1986, the first Federal court challenge to ECRA's constitutionality of covered sites changing ownership via stock transactions ended when the challenger, Cooper Industries of Texas, withdrew its suit against the Department. Cooper chose to enter into a Judicial Consent Order to acknowledge that ECRA was applicable to four New Jersey sites, acquired from McGraw Edison Inc.

The second ruling required Superior Air Products, Inc. to clean up contamination at a site, regardless of the former owner's possible contribution to the contamination, indicating that any necessary cleanup must supersede the determination of ultimate liability.

As of July 1987, Federal Superfund had contributed $108 million U.S. to activities in the State of New Jersey. By the end of fiscal year 1987, New Jersey had been guaranteed an additional $56 million of federal funds. A total of $277

million U.S. of federal funding was applied for in 1988. If approved, this would result in New Jersey obtaining 25% of the national share of funding available for activities in that year. In 1986, New Jersey received 21% ($17.4 million U.S.) of the national share of funding. The above indicates that New Jersey's approach to Superfund and remedial work in general is exceptionally well organized. The state aggressively pursues any available federal funding and minimizes state expenditure on these projects.

New Jersey has projected a cost of $1.6 billion U.S. over the five years (1988 - 1992) to clean-up 229 of the State's worst sites. Total available funding and the sources of the funding, as of July 31, 1987 is presented in Table 4.8.

Table 4.8
STATE OF NEW JERSEY
AVAILABLE FUNDING FOR SITE CLEAN-UP
ACTIVITIES AS OF JULY 31, 1987

Source	Funds ($ million U.S.)
New Jersey Spill Fund	$ 110.9
General State Fund	190
1981 Hazardous Waste Bond Fund	100
1986 Hazardous Waste Bond Fund	200
Federal Superfund	108
Total	$ 708.9

Reference: New Jersey DEP Comprehensive Management Plan, 1988-1992, dated October 1987.

As part of their "Five Year Plan", the State of New Jersey DEP developed estimates of annual expenditure on site clean-up activity until 1991. These are presented, along with a breakdown of the anticipated source of the funding, in Table 4.9. These estimates are based on an addition of

five NPL sites, and ten State funded sites per year to the inventory of problem sites, and costs of $15 million per year for waterline construction.

Table 4.9
STATE OF NEW JERSEY HAZARDOUS WASTE REMEDIATION
PROGRAM COSTS FISCAL YEARS 1987 - 1991
ALL SITES (NPL, Non-NPL, Water Supply Replacement)*
($ Millions)

	1987	1988	1989	1990	1991	Totals
State	77.50	160.70	186.10	141.90	74.30	640.50
Federal	62.40	132.50	166.10	108.40	28.20	497.60
Private	66.00	96.00	182.60	132.30	42.50	519.40
Total	205.90	389.20	534.80	382.60	145.00	1657.50

* Reference: New Jersey DEP Comprehensive Management Plan 1988-1992 dated October 1987.

4.3 IMPACT OF ON-SITE TREATMENT TECHNOLOGIES

The increasing trend towards on-site treatment at some clean-up and decommissioning projects will significantly impact on the quantities of material moved off-site at this type of project in the future. Trends in on-site bioremediation are discussed in CANVIRO (1988). Some additional general trends are discussed below.

4.3.1 TRENDS IN ON-SITE TREATMENT IN U.S.

When Superfund was initiated in 1980, if emergency sites were identified, material was excavated, removed off-site, and disposed at a secure landfill. In the intervening years, some of these landfills in their turn became Superfund sites, hence owners of the original waste may have to pay twice to have the waste removed.

Some Superfund remedial plans involved containment and capping of the sites in-situ. These were impermanent solutions directed at solving the immediate human health problem, and would have required additional work an estimated 30-50 years from the time they were originally implemented (Reference: OTA, 1985). It is felt that these measures have not totally eliminated the possibility of groundwater contamination, as the offending material is still in-place.

The Superfund Amendment Act (SARA), which was passed in 1986 stressed that land disposal of untreated hazardous wastes is not acceptable. The emphasis is now on destruction by incineration (either on or off-site), or some type of on-site or in-situ treatment, which significantly reduces the toxicity of the waste in question.

On-site and in-situ treatment is being developed and tested at a number of hazardous waste remedial projects in the U.S. These technologies include portable and/or mobile thermal destruction units (incinerators, plasma arc, etc) to handle organics and organic contaminated soils, solvent extraction or other chemical treatment systems for the same purpose, in-situ biodegradation of organic contaminated soils and groundwater, and land farming for biodegradation of organics. The Superfund Innovative Technology Evaluation (SITE) program has provided funds for testing of many on-site technologies, to promote their development. However, development and acceptance of these technologies is reportedly moving quite slowly, at least in part because of a bias towards the status quo, and existing technology, (Reference: Personal communication, R. Ogg CH2M Hill Inc.).

4.3.2 ON-SITE TREATMENT IN ONTARIO

On-site treatment of groundwater by relatively small treatment systems has been used at a number of remedial projects in Ontario, however, many of the technologies for on-site or in-situ treatment of contaminated soil have not been tested in a Canadian setting at full scale. With the exception of land farming, soil spreading for volatilization of contaminants and in-situ vapour extraction, on-site treatment of contaminated soil or sludges is not practiced extensively in Ontario at present, although this trend is expected to change in the future. As an example, vapour extraction is gaining popularity as a method of stripping volatiles from contaminated soils, and is being carried out at a number of gasoline spill clean-up projects identified during the course of this study.

A project will be initiated in 1988 to test a number of technologies for the treatment of contaminated groundwater at full scale at the Uniroyal Plant clean-up in Elmira. The study is jointly funded by the Ministry of the Environment, Environment Canada and Uniroyal, and is scheduled for completion by 1990. The results will establish the applicability of a number of these technologies in a Canadian setting and establish which can be used in remedial projects. The study results are likely to have an impact on the future of on-site versus off-site treatment in Ontario in general.

A further consideration is the possibility of the banning of land farming as a treatment option which is currently under consideration in the U.S. If implemented, this would have a significant effect on remedial projects, many of which can involve large volumes of contaminated soil, which can be treated by land farming at present. The land farming ban, which is under consideration by the USEPA at present, would

be strongly resisted if efforts were made to introduce it in Ontario or elsewhere in Canada. Oil companies use this treatment method extensively at present. As this issue is very speculative, it will not be given further consideration at this time for the present study.

On-site and in-situ processes are particularly attractive where a large volume of material is involved, as high mobilization costs are justified by the economics of the project. If on-site treatment and destruction technologies develop in the U.S. and are proven effective in a Canadian setting, this may alter the approach to decommissioning and site clean-up projects in Ontario substantially. Obviously, if materials can be treated on-site, significant transportation costs can be saved. If materials can be treated in-situ, the economics become even more attractive as excavation of large masses of material is eliminated.

For each remedial project, a decision on what remedial approach to use will be based on economics, and also practicality. It is likely that on-site technologies, even if available, will not be used at all sites, and that the economic viability of a treatment technology will depend on the volume of material to be handled, and on the location of the site.

Much of the above discussion is speculative, and can only be confirmed when the various technologies are further developed, both in the U.S. and Ontario. This is expected to occur within the next 3 to 4 years.

4.4 QUANTITIES OF MATERIAL PRODUCED BY DECOMMISSIONING AND SITE CLEAN-UP ACTIVITIES IN 1986 and 1987 IN ONTARIO

Information obtained on quantities of material produced by decommissioning and site clean-up activities in 1986 and 1987 in Ontario are presented in Tables 4.10 and 4.11, respectively. These tables were developed through discussions with a number of sources described in Chapter 2. They represent the information which the involved parties were willing to release, but are considered incomplete due to the confidential nature of many of these projects, and reluctance on the part of companies and consultants to divulge information, except in the case of well known projects. Tables 4.12 and 4.13 summarize the identified quantities of material produced in 1986 and 1987 in terms of their potential for on-site treatment, and also whether they could be candidate material for disposal at a hazardous waste facility.

The largest quantity of one single material produced by decommissioning in the last two years was 742,500 tonnes of asbestos waste, 740,000 tonnes of which was disposed in an on-site landfill. The remainder was disposed at a licenced landfill. It is likely that landfilling on-site will continue to be the preferred method of handling large quantities of this type of material, hence it is unlikely to require disposal at a hazardous waste facility in the future.

Oil contaminated soil was produced in large volumes by decommissioning activities (129,700 tonnes). Only a small amount (300 tonnes) was identified as being produced by site clean-up activities. At present, depending on the oil content, this material can be disposed at municipal landfills. This practice may be changed in the future if municipalities refuse to accept the material on the basis that it takes up valuable landfill capacity. On the other hand, this

Table 4.10
IDENTIFIED DECOMMISSIONING PROJECTS IN ONTARIO AND WASTES PRODUCED
1986 - 1987

Project	Date	Waste Quantity (tonnes)	Waste Type	Disposal Method
Bulk Oil Storage Facilities				
Bulk Oil Plant, Northern Ontario	June 1987	28,000	Oil contaminated soil	Municipal landfill
		Quantity not available	Tank bottoms	Municipal Landfill
Bulk Oil Storage Facility, Northern Ontario	1986	76,460	Oil contaminated soil	Stock piled at Old Parry Sound Landfill
Bulk Oil and Asphalt Plant, Southern Ontario	1987	780	Oil contaminated soil	Keele Valley Landfill
Bulk Oil Plant, Eastern Ontario	1987	4,720	Oil contaminated soil	Used as cover at local landfill
Bulk Oil Plant, Northern Ontario	1986	760	Oil contaminated soil	Huntsville landfill
Federal Facilities				
DND Lawther Radar Base	1987	Not available	PCB fluids	Stored at the CFB in North Bay

Table 4.10 (cont'd)
IDENTIFIED DECOMMISSIONING PROJECTS IN ONTARIO AND WASTES PRODUCED
1986 - 1987

Project	Date	Waste Quantity (tonnes)	Waste Type	Disposal Method
DND Falconbridge Radar Base	1986	Not available	PCB fluids	Stored at another DND base
DND Sioux Lookout, Radar Base	1987	Not available	PCB fluids	Stored at the CFB in Winnipeg
Industrial Sites				
Southern Ontario	1987	12,500	PCB contaminated soil	Storage on-site
S-W Ontario	1987	900	Plating sludges from lagoons	Tricil
Eastern Ontario	1987	200	PCB contaminated soil	Stored on-site
		14	PCB sludges	Stored on-site
		40 (200 drums)	PCB contaminated clothing, etc.	Stored on-site
S-E Ontario	1986 and 1987	600	Soil contaminated with metals	To city landfill
Southern Ontario	1987	740,000	Asbestos contaminated soil and asbestos cement wastes	Disposed on-site

Table 4.10 (cont'd)
IDENTIFIED DECOMMISSIONING PROJECTS IN ONTARIO AND WASTES PRODUCED
1986 - 1987

Project	Date	Waste Quantity (tonnes)	Waste Type	Disposal Method
Eastern Ontario	1986	16	Carbon disulphide gas	Back to supplier
		44,000	Lime sludge	Used as cover material at municipal landfill
Eastern Ontario	Prior to 1987	23	Petroleum Liquids contaminated with carbon black	Tricil
(Southern Ontario)	(January 1988)	(800)	(Soil contaminated with oil and grease)	(Municipal landfill)
Northern Ontario	1987	7	Paints and solvents	Chem. King
		11	Sulfonated cod oil	Chem. King
		5	Sulphuric acid	Chem. King
		18	Waste Tannery Sludge	Tricil
		6	Tanning oils	Chem. King
Mines				
Northern Ontario	1987	5 (25 drums)	PCB contaminated material	Stored on-site

Table 4.10 (cont'd)
IDENTIFIED DECOMMISSIONING PROJECTS IN ONTARIO AND WASTES PRODUCED
1986 - 1987

Project	Date	Waste Quantity (tonnes)	Waste Type	Disposal Method
Refineries				
Shell, Oakville Refinery	1983-1986	5	Leaded sludges	Tricil
		3,600	Materials from on-site landfill	Licenced landfill
		2,500	Asbestos Insulation	Licenced landfill
		1,750	Tank Sludges	Land farmed on-site
		9,000(±)	Oil contaminated soils	Land farmed on-site
	(1988)	(10,000)	(Molybdenum contaminated soils)	(Steetly and other licenced landfill)
Texaco Refinery Port Credit	1986±	10,000	Oil contaminated soil from "middle site"	Municipal landfill
Total	1986-1987	189,804*		

* Excluding 16 t of carbon disulphide gas returned to supplier, and 740,000 t of asbestos wastes landfilled on-site, 2500 t of asbestos insulation and 3600 t of material from on-site landfill which were removed to an industrial landfill. Work carried out in 1988 not included in total. Total is 937,720 tonnes if all these streams included.

Table 4.11
IDENTIFIED SITE CLEAN UP PROJECTS IN ONTARIO, AND
WASTES PRODUCED
1986-1987

Project	Date	Waste Quantity (tonnes)	Waste Type	Disposal Method
Coal Gasification Site Clean-ups				
Lees Avenue	See "Construction Sites"			
Waterloo City Hall ..	See "Construction Sites"			
Chippawa Creek Coal Tar Clean-up	1986	1,200	Coal tar contaminated soils	Stored in lagoon on-site
	1987	1,200	Coal tar contaminated soils	Stored in Lagoon on-site
King Edward Coal Gas Plant Site, Ottawa	1986	45 46	Liquid with BAP Coal tar contaminated soil	Retained in tankers Stockpiled off-site
Berkley St. Coal Gas Plant Site, Toronto	1987	2,000*	Coal tar contaminated soil	Soil with <1ppb benzo-a-pyrene to the Keele Valley landfill site. Soil with >1ppb benzo-a-pyrene to Tricil
		1,000	PAH contaminated water	On-site treatment
Gas Station Clean-ups				
Southern Ontario	1987	300	Oil contaminated soil	Municipal landfill

Table 4.11 (cont'd)
IDENTIFIED SITE CLEAN UP PROJECTS IN ONTARIO, AND
WASTES PRODUCED
1986-1987

Project	Date	Waste Quantity (tonnes)	Waste Type	Disposal Method
Industrial Sites				
Southern Ontario	1987	390 (1932 Drums)	Miscellaneous solvents and other organic chemicals	Tricil
		3,270	Contaminated soils and solids	Tricil
Southern Ontario	1987	15,000	PCB contaminated soil	Stored on-site
Eastern Ontario	1986	2,000	Toluene contaminated soil	Municipal landfill
Eastern Ontario	1986	3,000	Soil with heavy metals	Placed in landfill on-site
Eastern Ontario	1987+	25	PCB contaminated soil and asphalt	On-site storage
Western Ontario	1987	(71 Drums) 15	Miscellaneous wastes	Tricil
S-W Ontario	1987	2,800	PCB contaminated soil	Stored in vault on-site
Eastern Ontario	1987	200	Miscellaneous drummed wastes (organic and phenols)	Tricil/Stablex

Table 4.11 (cont'd)
IDENTIFIED SITE CLEAN UP PROJECTS IN ONTARIO, AND
WASTES PRODUCED
1986-1987

Project	Date	Waste Quantity (tonnes)	Waste Type	Disposal Method
Eastern Ontario	1986	720	Ferric arsenite	Storage in on-site lagoons
	1987	720		
Southern Ontario	1987	2	Cyanide wastes	Tricil
Miscellaneous				
South Riverdale	1987	2,100	Lead contaminated soil	Municipal landfill
Old Landfills				
Gloucester Landfill Clean-up, Ottawa	1987	29 (148 Drums)	DDT aerosol cans	Stablex
		1 (4 Drums)	CN/DDT wastes	Stablex
		128	Bulk wastes (soil with inorganics)	Stablex
		1,600	Bulk soil	
Sites Discovered During Construction Activities				
Waterloo City Hall Coal Tar Site Clean-up	1986/87	24,000	Soil with light coal tar contamination	Municipal landfill
	1987	3,500	Coal tar residues	Tricil

Table 4.11 (cont'd)
IDENTIFIED SITE CLEAN UP PROJECTS IN ONTARIO, AND
WASTES PRODUCED
1986-1987

Project	Date	Waste Quantity (tonnes)	Waste Type	Disposal Method
Lee's Avenue Coal Gas Plant Site, Ottawa	1986	22	Coal tar	Stablex
	1986	1,000	Contaminated water	Stablex
	1987	1,000	Coal tar contaminated soil	Stablex
	1987	100	Coal tar contaminated sludge	Stablex
CN Toronto Dome Site	1987	Not available	Contaminated soil	Being used on-site
Lax Property Hamilton	1986	5,200	Iron oxide wastes (hazardous)	Treated by Philips Enterprises to render non-hazardous, disposed at Walker Bros. landfill
		450	Foundry wastes (non-hazardous)	Steetly Industries
Private Property Sudbury	1987	570*	Soil contaminated with coal tar derivatives	Hazardous-Tricil, Non-hazardous local landfill
PCB Clean-ups				
Pottersburg Creek PCB Clean-up	1986	21,900	PCB contaminated soil	Stored in vault on-site
	1987	15,750	PCB contaminated soil	Stored in vault on-site
TOTAL		111,283		

* Assume 20:80 split, hazardous to non-hazardous

Table 4.12
ANALYSIS OF IDENTIFIED DECOMMISSIONING WASTES (1986 - 1987)

Type of Material	Waste Quantity (Tonnes)	Present Disposal Method
PCB Contaminated Soils	12,700	On-Site Storage
PCB Sludges	14	On-Site Storage
PCB Contaminated Clothing	45	On-Site Storage
Oil Contaminated Soil	120,720	Municipal Landfill
	9,000	Landfarmed On-Site
Organic oily tank sludges	1,750	Landfarmed on-site
Material from on-site landfill (building debris, etc.)	3,600*	Licenced landfill
Asbestos Insulation	2,500*	Licenced landfill

Table 4.12 (cont'd)
ANALYSIS OF IDENTIFIED DECOMMISSIONING WASTES (1986 - 1987)

Type of Material	Waste Quantity (Tonnes)	Present Disposal Method
Asbestos Contaminated Soils and Asbestos Cement Wastes	740,000*	On-site landfill
Metal Contaminated Soil	600	City Landfill
Lime Sludge	44,000	Municipal Landfill
Plating Sludges	900	Tricil
Miscellaneous Inorganic Wastes	34	Hazardous Waste Facility and Licenced Landfill
Miscellaneous Sludges Organic Wastes	41	Tricil
Total	189,804*	

* Total excluding asbestos and inert wastes

Table 4.13
ANALYSIS OF IDENTIFIED SITE CLEAN-UP WASTES (1986 - 1987)

Type of Material	Waste Quantity (Tonnes)	Present Disposal Method
Coal Tar Contaminated Soil	26,060	Municipal Landfill
	2,446	Stored in Lagoon On-Site
Coal Tar Residues Heavily Contaminated Soil	5,132	Tricil/Stablex
Coal Tar Contaminated Water/Liquid	1,045	Stablex
	1,000	On-site treatment
PCB Contaminated Soil	55,475	On-Site Storage
Oil Contaminated Soil	300	Municipal Landfill
Toluene Contaminated Soil	2,000	Municipal Landfill
Soil with Heavy Metals (Lead + Tannery Wastes)	3,000	On-site Landfill
Lead Contaminated Soil	2,100	Municipal Landfill

Table 4.13 cont'd
ANALYSIS OF IDENTIFIED SITE CLEAN-UP WASTES (1986 - 1987)

Type of Material	Waste Quantity (Tonnes)	Present Disposal Method
Soil Contaminated with Mixed Wastes	3,270	Tricil
Soil Highly Contaminated With Inorganics	128	Stablex
Soil Lightly Contaminated With Inorganics	1,600	Licenced Landfill
Miscellaneous Inorganic, Organic, Mixed, Drummed Wastes	634	Tricil and Stablex
Ferric Arsenite	1,440	On-site storage. Will ultimately be capped on-site
Iron Oxide	5,200	Treated off-site to render non-hazardous, disposed at licenced landfill
Foundry Sands	450	Licenced Landfill
Cyanide Wastes	3	Tricil/Stablex
Total	111,283	

* For preliminary analysis, assumed that disposal of contaminated soils at municipal/licenced landfills would continue. Issues involved are discussed in Section 4.4.

material is reported to make an excellent landfill cover material, hence it is likely that it will continue to be accepted where it can be used as daily cover. If oil contaminated soil is not accepted at municipal landfills, options open to waste owners will then be limited to licenced industrial landfills, hazardous waste facilities, or on-site treatment by either land farming, biodegradation or vapour extraction depending on the contaminant. Disposal at a hazardous waste facility would be the least desirable of these options from an economic point of view.

Approximately 55,500 tonnes of site clean-up materials and 12,760 tonnes of decommissioning wastes were PCB related, all of which would be candidate materials for the disposal at a suitably equipped facility. All of this material was considered to have potential for on-site treatment depending on a number of factors. Where large volumes of PCB contaminated soil are involved, on-site treatment would likely be the preferred handling method, if economical. However, it is also possible that companies would elect to remove PCB contaminated material off-site, to dispose of the liability associated with the material.

An estimated 44,000 tonnes of lime sludge from one decommissioning project was used as daily cover at a municipal landfill. This is likely to be the preferred disposal method for this type of material unless landfills refuse to accept it because of capacity restricitions. Metal contaminated soil has been accepted by municipal landfills, depending on the metals levels, however, this practice may change in the future because of capacity restraints discussed earlier. Options for disposal would then be limited to a licenced industrial landfill, or to a hazardous waste facility, although the latter is unlikely because of higher disposal costs. An identified 600 tonnes of soil contaminated with metals was produced by decommissioning activities, and was disposed at a municipal landfill.

Clean-up activitiesproduced an identified total of 5,100 tonnes of meta contaminated soil, 3,000 tonnes of which was disposed in an on-site landfill. The remaining 2,100 tonnes was disposed at a municipal landfill.

The 900 tonnes of plating sludges produced during an identified decommissioning project were disposed at Tricil. However, a recent project in Ontario (for which detailed quantities were not available) involved in-place solidification of plating sludges, which may gain populatity in the future, if economically justifiable.

A significant quantity (35,700 tonnes) of coal gasification related wastes were produced by at least five identified clean-up projects carried out during 1986 and 1987. Highly contaminated coal tars and sludges were disposed at a hazardous waste facility. Lightly contaminated soils were disposed at municipal landfills. This practice will probably continue unless municipalities refuse to accept the material for capacity reasons in the future. This material is considered amenable to on-site biotreatment, (currently used by Environmental Solutions of Louisianna at some coal gasification projects in the U.S.).
It is possible that this technology may be tried in Ontario at a future time.

Clean-up activities also produced 5,200 tonnes of iron oxide waste which was removed off-site by a waste disposal company who treated the material to render it non hazardous. It was then disposed at a licenced landfill. This function could also likely be served by the OWMC, if economically competitive with the waste management company.

Two streams of soil contaminated with inorganics, organics and mixed wastes accounted for approximately 3,400 tonnes of

waste, and were disposed at hazardous waste facilities. It is unlikely that the stream of mixed waste would be amenable to on-site treatment, because of the mixed nature of the contaminants, hence it is likely to continue to require disposal at a hazardous waste facility. Solidification of the soil contaminated with inorganics could be considered, depending on the nature of the contaminants.

A further 1,600 tonnes of soil lightly contaminated with mixed wastes was disposed at a licenced landfill. It is unlikely that this waste would be treated on-site, because of the low contamination levels involved.

Miscellaneous drummed wastes, which included organic, inorganic and mixed wastes, accounted for approximately 710 tonnes of decommissioning and clean-up wastes (75 tonnes from decommissioning, the remainder from clean-up). Off-site disposal at a hazardous waste facility is likely to continue as the preferred method of handling these wastes, as they are not considered amenable to on-site treatment for economic reasons because of the small volumes and the high mobilization costs involved.

Summary of Waste Disposal Methods

Of the 936,000 tonne total quantity of materials produced by decommissioning activities in the last two years, 740,000 tonnes were landfilled on-site, 171,420 tonnes were disposed at licenced municipal and industrial landfills, 12,760 tonnes are PCB related material stored on site, 10,750 tonnes were landfarmed on-site and 975 tonnes were disposed at hazardous waste handling facilities.

The evaluation of waste produced through site decommissioning activities in 1986-1987 shows that relatively low quantities of subject waste are produced, totalling 975 tonnes over a two year period, if PCB wastes are excluded.

Of the 111,300 tonne identified total quantity of materials produced by site clean-up activities in the last two years, approximately 59,400 tonnes are stored on site, 37,700 tonnes went to a licenced landfill, 3,000 tonnes were landfilled on-site, 1,000 tonnes of contaminated water were treated on-site and 10,200 tonnes of waste were disposed at hazardous waste handling facilities. An estimated 75,780 tonnes of the total was subject waste, approximately 55,500 tonnes of which was PCB related. Hence, excluding PCB wastes, approximately 18% of site clean-up material is subject waste.

4.5 FUTURE QUANTITY PROJECTIONS IN OTHER JURISDICTIONS

Section 4.2 discussed the level of clean-up and remedial activity in different areas of the U.S. Where information was available, funding was also addressed to illustrate the amount of money required to finance large scale clean-up activity.

Projections of future levels of activity estimated in other jurisdictions were reviewed during this study to ascertain if the methodologies and assumptions employed were directly applicable to a similar exercise carried out for Ontario. Projections carried out for Federal Superfund and New Jersey State are discussed briefly in this section, and some back-up data is included in Appendix E of this report for reference.

Federal Superfund Sites

Extensive work was carried out for the USEPA on quantity projections for RCRA facilities as a result of CERCLA clean-up activities. Three of these reports were reviewed

while conducting the present study. All of the reports were prepared in 1985, prior to enactment of SARA which basically imposes a ban on the direct landfilling of untreated wastes. Hence, projections and assumptions used in these reports are no longer valid, given the mandatory requirement for waste treatment (either on-site or off-site) resulting from SARA.

Discussions were held with USEPA officials on more up to date projections of waste quantities generated by clean-up of Superfund sites. The USEPA now projects quantities only one year ahead, and cautions against longer term projections, because of the levels of uncertainty regarding this topic. (Personal communication, Linda Gayler USEPA) The results of one of the EPA studies are shown on Table 4.14 for information.

New Jersey

The most recent New Jersey Hazardous Waste Facilities Plan (March 1985) estimated that 78,000 tons per year (approximately 71,000 tonnes per year) of waste could be expected from clean-up activities in that State in the years 1985 to 1988, assuming that 97 of 141 sites to be cleaned up might generate waste for off-site disposal. Background information to the projection is included in Appendix E of this report. ECRA had only been in place for a short time when the projection was prepared, hence the plan stated that the 1988 update would provide a much more accurate assessment of likely clean-up activity. The updated plan is in preparation at present, and will be completed in late 1988.

The 1985 plan stressed that the projection should be viewed as an order of magnitude estimate only, suitable for sizing a hazardous waste facility.

Table 4.14
PROJECTIONS BY WASTE TYPE EXPECTED TO BE
ENCOUNTERED AT SUPERFUND SITES OVER THE NEXT FIVE YEARS*

Contaminated Source Material

Waste Type	Aqueous Liquid (million U.S. gals) (no groundwater)	Sludges (million cu.yds)	Soils (million cu.yds)	Organic Liquid million U.S.(gals)
Volatile Organics	582	1-4	7-12	42-52
Metals	374	2.4 - 3.6	4.4 - 7.6	NA
PCB and Dioxin	140	0.98- 1.26	3.0 - 4.9	12-45
Other Organics	217	1.5 - 4.4	4.7 -13.1	19.5- 67.5
Pesticides	61	0.02- 0.43	0.65- 1.34	5.4- 15.7
Radio-active	54	0.38	1.2	NA
Asbestos	NA	0.09- 0.12	0.09- 0.12	NA
Explosives	38	0.27	0.84- 2.3	NA
Total	1,466	6.64-14.56	21.88-42.56	78.9-180.2
Total (Millions of tonnes)	5.54	5.12-11.23	33.74-65.66	0.3- 0.68

Note: Table developed on basis of information on 66 NPL sites, projected for 402 sites over a five year period. Total volumes of contaminated source material are not calculated because of double-counting of waste types would result in exagerated totals.

* CDM, Review Draft Report to EPA "Capacity and Capability of Alternatives to Land Disposal for Superfund Wastes - Waste Type and Quantity Projections" September 1985.

4.6 FUTURE QUANTITY PROJECTIONS FOR ONTARIO

4.6.1 GENERAL

The general concensus of both workshops convened to discuss this topic was that activity in the decommissioning and clean-up areas is expected to increase in future years, however, participants were reluctant to hazard a guess as to the magnitude of this increase because of the number of factors involved. A discussion of these factors is presented in the next section, but is general in nature. The information obtained on existing decommissioning and clean-up activity is considered incomplete, because of the nature of clean-up projects. Consultants involved can not divulge information because of client confidentiality, and site owners are reluctant to discuss past, ongoing or proposed clean-up or decommissioning projects. The data obtained from the MOE Regional and District offices provided a valuable guide to this study, and even though considered incomplete, was used to carry out some preliminary estimates of future activity in this area. All estimates contained in this report are considered likely to be underestimates, because of the data on which they are based.

Two methodologies were employed to develop a preliminary estimate of future wastes produced by site clean-up and decommissioning activities in Ontario.

The first method looked at the total number of sites identified in each category during 1986-1987, and divided the total waste quantity produced by the number of sites to give an average per site quantity. Assumptions were then made on the likely increase in level of activity in these areas in the future, based to a large extent on discussions carried out with consultants working in these areas, industry

representatives and government officials, and also on our own best professional judgement of likely future scenarios.

The second methodology involved a disaggregate analysis of the likely future level of activity anticipated for a number of different types of projects eg. PCB clean-up, decommissioning of refineries etc. again based on discussions with other consultants, industry and government representatives. Best professional judgement was used to develop a likely future scenario in each case. This was obviously a subjective assessment on which professional opinions may differ. The results of each methodology are presented below.

4.6.2 ESTIMATE OF FUTURE DECOMMISSIONING WASTE QUANTITIES IN ONTARIO - METHODOLOGY NO. 1

The study survey identified a total of 19 sites which were decommissioned in Ontario in 1986-1987, resulting in an average of 10 sites per year, producing an identified annual average quantity of 94,900 tonnes (excluding asbestos and inert wastes), approximately 490 tonnes of which was non-PCB subject waste. This level of activity is expected to increase somewhat with close down of older plants, amalgamation of companies, streamlining of some industrial activities and increased pressure on urban property for residential/commercial development. If the Free Trade agreement currently under discussion with the U.S. is ratified, its implications on some industries are expected to result in plant shut-downs. In the absence of certain knowledge on a number of these issues and based on discussions at a workshop convened to discuss the topic in November 1987, it was assumed that decommissioning activities would increase by 25%. In the absence of more detailed information, it has been assumed for preliminary planning purposes that the quantities of material involved would be proportional to those currently produced, and would

total approximately 120,000 tonnes per year, 610 tonnes of which would be considered non-PCB subject waste. Based on existing information most of this material would be inorganic plating sludges, and approximately 10%, or 61 tonnes would be mixed inorganic and organic drummed wastes. Based on existing quantities, up to 8000 tonnes of the total estimated waste quantity would be PCB contaminated soil. PCB contaminated oils and equipment generated as a result of decommissioning activity are dealt with in a separate study underway by M.M. Dillon at the time of writing.

4.6.3 ESTIMATE OF FUTURE DECOMMISSIONING WASTE QUANTITIES IN ONTARIO - METHODOLOGY NO. 2

The second methodology used to forecast future decommissioning waste quantities assessed the likely future scenario for a number of different types of projects. Future projects were divided into the following categories based on existing or projected experience and activity:

- PCB contaminated sites
- Bulk oil storage facilities/major terminals
- Refineries
- Miscellaneous industrial sites
- DND Bases
- Waste transfer and waste management facilities
- Gas stations

Assumed future trends are discussed in Appendix F, and the results of the analysis are summarized in Table 4.15. The results of the analysis indicate an estimated future annual waste quantity of 92,400 tonnes from decommissioning activities, 4900 tonnes of which would be subject waste, consisting of an estimated 3400 tonnes of PCB contaminated soil and 1500 tonnes of miscellaneous organic and inorganic wastes.

Table 4.15
ESTIMATE OF FUTURE DECOMMISSIONING WASTE QUANTITIES IN ONTARIO
METHODOLOGY NO. 2

Site Type	Identified Current Average Annual Quantity (tonnes)[a]	Estimated Future Annual Quantity (tonnes)	Estimated Future Subject Waste Component (tonnes)
PCB Sites - industrial - utility - mining - federal	6,400	3,400	3,400
Bulk Oil Storage Facilities/Major Terminals	55,360	55,000	0
Refineries	10,850[b]	0	0
Miscellaneous Industrial	22,790[c]	23,000	500
DND Bases	Not identified	0	0
Abandoned Waste Transfer & Management Facilities	0	5,000	1,000
Gas Stations	(6,000)[d]	6,000	0
TOTAL	101,400[c]	92,400	4,900

(a) Based on 1986 and 1987 identified quantities
(b) Inert wastes excluded
(c) Asbestos waste excluded
(d) Quantity estimate based on general discussions with consultants

4.6.4 ESTIMATE OF FUTURE SITE CLEAN-UP WASTE QUANTITIES IN ONTARIO - METHODOLOGY NO. 1

Future site clean-up waste quantities are difficult to predict with any degree of accuracy because of the number of factors involved. The study survey identified a total of 22 site clean-ups or 11 clean-ups per year were underway in the Province in 1986-1987. As discussed previously, this is considered an under-estimate of the current level of activity, but additional data could not be obtained to confirm this. It is reasonable to assume that this level of activity will increase in the future, due to a number of factors, including an expected increased attention to inventory development, increased awareness of environmental liability associated with contaminated property and increased environmental surveillance expected in the coming years. As an example, construction starts on clean-up projects in New Jersey are at 11 per year at present, and will probably increase to 30-40 sites per year in the coming years, excluding ECRA activities. Clean-up projects associated with ECRA currently account for an additional 100 projects of varying sizes annually.

Based on discussions with consultants, regulators and industries involved, it is anticipated that site clean-up projects in Ontario may increase substantially in the future. An estimate of up to 100% greater than current activity levels was developed at a workshop convened on this topic in November 1987. During 1986-1987 identified projects produced an average of 56,000 tonnes per year of waste, 37,900 tonnes of which was subject waste (27,500 tonnes PCB related). Pro-rating the total identified quantities produced in 1986-1987 this results in a projected annual waste quantity generation of 112,000 tonnes,

approximately 20,800 tonnes of which would be non-PCB subject waste. Based on existing quantities, up to 55,000 tonnes of the total would be PCB related subject waste.

Because it is considered likely that less large PCB clean-up projects will be carried out in the future, the second methodology developed to estimate future site clean-up quantities provides what is considered to be a more realistic estimate of future quantities of PCB related wastes.

4.6.5 ESTIMATE OF FUTURE SITE CLEAN-UP WASTE QUANTITIES IN ONTARIO - METHODOLOGY NO. 2

The second methodology used to forecast future quantities assessed the likely future scenario for a number of different types of projects in the following categories:

- PCB clean-ups
- Coal gasification sites
- Old landfills
- Gas stations
- Industrial sites
- Construction sites

Assumed future trends are summarized in Appendix G and the results of the analysis are summarized in Table 4.16.

The results of the analysis indicate that an estimated 82,100 tonnes of waste would be produced annually by site clean-up activities. An estimated, 20,700 tonnes of this total would be subject waste, consisting of 9,600 tonnes of PCB contaminated soil and 11,100 tonnes of miscellaneous organic, inorganic and mixed wastes.

Table 4.16
ESTIMATE OF FUTURE SITE CLEAN-UP WASTE
QUANTITIES IN ONTARIO - METHODOLOGY NO. 2

Site Type	Identified Current Average Annual Quantity (tonnes)[a]	Subject Waste Fraction of Identified Current Average Annual Quantity (tonnes)	Estimated Future Average Annual Quantity (tonnes)	Estimated Future Subject Waste Component (tonnes)
PCB Clean-ups[b]	18,825	18,825 (PCB)	4,200	4,200 (PCB)
Coal Gasification Sites	2,745	200	5,500	400
Old Landfills	880	80	1,800	200
Gas Stations	16,500[c]	0	16,500	0
Industrial	14,061	8,913 (PCB)	28,000	5,400 (PCB) 3,800 (Non PCB)
Construction	24,276[c]	5,968	24,000	6,700
Miscellaneous	1,050	0	2,100	0
TOTAL	78,337[c]	27,738 PCB 6,248 organic, inorganic, mixed	82,100	20,700 (9,600 PCB, 11,100 organic, inorganic, mixed

(a) Based on identified 1986 and 1987 quantities.
(b) Some PCB clean-up projects in industrial section
(c) Quantities adjusted to reflect likely totals. See Appendix G for details

4.6.6 DISCUSSION OF FUTURE PROJECTIONS

Two methodologies were used to estimate future quantities of material likely to be produced by site decommissioning and clean-up activities in Ontario. Results of the two analyses are summarized on Table 4.17. The projections have a number of limitations, as outlined below:

1. Projections of future activity were based on existing identified quantities produced by these activities in a two year period. As discussed previously this information is considered incomplete, therefore the projections are likely an underestimate.

2. The methods projected 750-1,500 tonnes per year of non-PCB related subject waste from decommissioning activities, and 11,100-20,800 tonnes per year of subject waste from site clean-up activities.

3. Methodology No. 1 is a more general approach, based on best professional judgement of the percentage increase likely to occur in these areas. The projected quantities of PCB related wastes produced by this method are considered an over-estimate as activity in PCB related projects is considered likely to decrease in the future for reasons outlined in more detail in Chapter 3.

4. Methodology No. 2 is considered more thorough as it looks at each type of site separately, hence the quantities of subject waste forecasted by this method are likely more realistic than those forecasted by

Table 4.17
COMPARISON OF FUTURE WASTE QUANTITY ESTIMATES FOR
DECOMMISSIONING AND SITE CLEAN-UP ACTIVITIES

	Total Waste Quantity (tonnes per year)		Subject Waste Quantity (tonnes per year)			
	Method No. 1	Method No. 2	Method No. 1		Method No. 2	
			PCB* Contaminated Soil	Organic, Inorganic & Mixed	PCB Contaminated Soil	Organic, Inorganic & Mixed
Decommissioning	120,000	92,400	8,000*	750	3,400	1,500
Site Clean-up	112,000	82,100	55,000*	20,800	9,600	11,100
TOTAL	232,000	174,500	63,000*	21,550	13,000	12,600

* Considered an over-estimate.

Methodology No. 1, particularly for PCB related wastes.

5. Methodology No. 2 forecasts a total of 174,500 tonnes of waste from both sources in future, compared to 150,500 tonnes per year currently produced and 232,000 tonnes projected by methodology No. 1. This result was somewhat surprising, considering the general concensus among consultants, regulators and industry that activity in this area is expected to increase substantially in the future. However, the level of activity is expected to decrease for certain project types which currently produce large volumes of waste.

The majority of the waste produced is projected to be contaminated soil. Current practice is to dispose of this material at municipal landfills, however, it is possible that this practice may have to change in the future, if sanitary landfill capacity becomes a more critical issue. It is unlikely that this soil would be disposed at a hazardous waste facility for economic reasons, however, in the unlikely event that it was necessary to do so, it is clear from the above discussion (which is considered an underestimate) that the volumes of material involved would be significant.

Based on methodology no. 2 assumptions and estimation techniques a quantity of 12,600 tonnes per year of miscellaneous subject waste was estimated for site clean-up and decommissioning activities in the future. Past experience shows that subject wastes from site clean-up and decommissioning activities can be expected to vary from plating sludges to coal tar residues, with some drums of mixed organic and inorganic wastes. It is impossible to predict with a high degree of accuracy what the mix may be in future years, however, based on discussions held

during a workshop convened as part of this study, it was considered reasonable to assume that the subject waste fraction would be 60% organic, 20% inorganic and 20% mixed wastes for planning purposes. An estimated 13,000 tonnes per year of PCB contaminated soils were also estimated by methodology no. 2. This may decrease further in future, and is significantly lower than the identified 34,100 tonnes per year currently produced.

Table 4.18 presents some preliminary estimates of the likely on-site off-site allocation of the estimated subject wastes, and also the OWMC classes to which they may belong. This has been provided for planning purposes, and is based on the nature of waste currently being produced. The allocation assumes that relatively smaller quantities of waste would likely be disposed off-site, assuming mobilization costs would render on-site treatment uneconomical, unless large quantities of waste were involved.

Based on current information and experience most decommissioning and clean-up activity is related to industrial land use, therefore it is probably reasonable to assume a regional distribution which mirrors the current industrial distribution in the Province.

Much of the above discussion and analysis is subjective, but provides preliminary quantities which are appropriate for planning purposes. The methodology has been developed so that it can be easily updated at a future time as additional information becomes available.

Table 4.18
ESTIMATED IDENTIFICATION AND ALLOCATION OF FUTURE
SITE CLEAN-UP AND DECOMMISSIONING WASTE QUANTITIES

Waste Description	Waste Quantity (tonnes)	OWMC Waste Class Number	Potential for On-Site Treatment	Likely Scenario	
				On-site	Off-Site
PCB Contaminated Soils	13,000	13	Yes	6,500*	6,500
Organic Wastes	2,500	1	Yes	0	2,500**
	2,500	5	Yes	0	2,500**
	2,600	14	Yes	0	2,600**
Inorganic Wastes	2,500	6	Potential Solidification	0	2,500**
Mixed Wastes	1,250	7	No	0	1,250**
	1,250	14	No	0	1,250**

* The future of on-site treatment of PCB contaminated soils in Ontario will be better defined after the Smithville PCB clean-up project has been completed. These estimates should be adjusted at that time.

** Assumes that off-site treatment would be preferred because of small quantities of waste involved.

Chapter 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

1. A telephone survey was carried out to indentify wastes produced by decommissioning and clean-up activity in the Province. Significantly more data was obtained on projects carried out in 1986 and 1987, than in previous years. However, the data collected is considered incomplete, because of the confidential nature of many of these projects. Hence, waste quantities discussed are considered to be underestimates.

2. In 1986 and 1987 site decommissioning produced approximately 95,000 tonnes per year of waste material, less than 0.5% of which was subject waste, if PCB wastes are excluded. In 1986-1987, PCB wastes accounted for approximately 6.7% of the total quantity. Most of the material produced by decommissioning activities was contaminated soil, which was generally disposed at municipal landfills.

3. In 1986 and 1987 site clean-ups produced approximately 56,000 tonnes per year of waste material. In 1986 and 1987, approximately 50% of the total was PCB related, and an additional 10,400 tonnes per year was non-PCB subject waste. Hence, site clean-up activities produced a greater proportion of subject waste than site decommissioning projects.

4. A number of factors will impact on site clean-up and decommissioning in the future. The net result of these is an expected increase in activity.

5. Two methodologies were used to estimate future waste quantities produced by site clean-up and decommissioning activities. Results for total quantities varied, but results for subject waste quantities agreed reasonably well.

6. Based on the methods and assumptions used and the 1986 and 1987 data collected, future decommissioning activities are estimated to produce 92,400-120,000 tonnes of waste per year. The total quantity includes an estimated 3400 to 8000 tonnes of PCB contaminated soils and 750 to 1500 tonnes of other subject waste, consisting of organics, inorganics and mixed waste. The balance of the total is likely to consist primarily of contaminated soil. This is typically disposed at municipal landfills at present. If current practice were to change it may be necessary to dispose of some of this material at a hazardous waste facility, although it is expected that this would be undesirable from an economic point of view.

7. Based on the methods and assumptions used, and the 1986-1987 data collected, future clean-up activities are estimated to produce 82,100-112,000 tonnes of waste per year. The total quantity includes 9600 to 55,000 tonnes of PCB contaminated soils and 11,100 to 20,800 tonnes of subject waste, consisting of organics, inorganics and mixed waste.

8. The methodology which provided the lower numbers discussed above is considered a more reliable estimate of future waste production. Therefore, based on the analysis carried out in this study, clean-up and site decommissioning are projected to produce at least 25,600 tonnes per year of subject waste, approximately 50% of which is PCB related. For planning purposes, it

is considered reasonable to assume that 7,600 tonnes would be organic wastes, 2,500 tonnes would be inorganic wastes and 2,500 tonnes would be mixed wastes. A constant rate of production has been assumed for the years 1992-1997. This is considered a conservative approach as it is possible that activity may increase during these years.

9. A regional distribution of sources is difficult to estimate, however, it is reasonable to assume that the distribution will mirror industrial activity in the Province, with a greater proportion of site clean-up and decommissioning occurring in highly industrialized areas.

10. Development of on-site and in-situ treatment technologies is likely to impact on the quantities of waste removed off-site in the future. It is anticipated that this factor may result in a net decrease in off-site removal of waste, however, it is too early to comment on likely development of this trend at this time.

5.2 RECOMMENDATIONS

1. The above quantities are approximations only, based on the best information available at this time. This topic is likely to change with each year of additional available information. A survey should be carried out of all site clean-up and decommissioning activity carried out in 1988, to provide at least three years of data on which to develop future quantity estimates. This report should be updated at least every two years (or more frequently if appropriate), to reflect changes in Provincial and Federal regulations, available

funding, attitudes to environmental liability and other factors which impact on the level of decommissioning and site clean-up activity in the Province.

APPENDIX A

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REFERENCES

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APPENDIX B

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APPENDIX D

DESCRIPTION OF SOME LEGISLATION IN THE U.S. RELATED TO DECOMMISSIONING AND SITE CLEAN-UP

APPENDIX D

DESCRIPTION OF SOME LEGISLATION IN THE U.S.
RELATED TO DECOMMISSIONING AND SITE CLEAN-UP

D.1 U.S. FEDERAL LEGISLATION

CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) or Superfund Act

This Act was passed in 1980 to address the worst environmentally hazardous sites in the U.S., which were threatening human health. The second major objective of the Act, (which received $1.5 billion U.S. funding over a five year period) was to gather information on the extent of the national problem in the U.S. and develop options for its solution.

SARA (Superfund Amendments Reauthorization Act)

SARA was passed in 1986, and involved a restructuring of the Superfund program. A two part strategy was recommended as follows:

1) In the near term (15 years ±)
   - o Early identification and assessment of NPL (National Priorities List) sites
   - o Initial response to reduce near term threats from hazardous sites
   - o Permanent clean-ups for especially threatening sites
   - o Develop institutional capabilities for long term program

2) In the long term carry out extensive site studies and implement permanent clean-ups.

A total of $9 billion U.S. is available for SARA implementation over the next 5 years. SARA stresses that land disposal of untreated waste is no longer a viable option for hazardous waste, and that permanent solutions (ie. destruction, lowering of toxicity, etc) must be found.

SARA states that "to the maximum extent practicable the remedial action to be selected must permanently and significantly reduce the volume, toxicity or mobility of hazardous substances, pollutants and contaminants."

RCRA (Resource Conservation and Recovery Act)

Federal Resource Conservation and Recovery Act (RCRA) of 1976 was intended to regulate waste handlers, transporters and generators, as well as those who treat, store or dispose of these wastes. The Hazardous and Solid Waste Amendments Act of 1984 broadened the scope of RCRA to include small quantity generators of hazardous waste, require the development and implementation of a program to reduce the risk of groundwater contamination from underground storage tanks, restrict land disposal of hazardous waste, and require clean-up of past land disposal practices not previously covered under RCRA.

D.2 STATE OF NEW JERSEY

New Jersey has been an innovator in development of legislation to control pollution, and has an extensive remedial program underway. Perhaps the most innovative of New Jersey's many regulations is ECRA, described below.

New Jersey ECRA (Environmental Clean-up Responsibility Act)

This act, established in the State of New Jersey in 1984, applies to industrial establishments in major US/SIC codes

22-39, 46-49, 51 and 76. The act required that prior to sale, transfer or closure of an industrial property involved in the generation, manufacture, refining, transportation, treatment, storage, handling, and disposal of hazardous substances, the property owner must prove that it is uncontaminated. If contaminated, the industry is responsible for all clean-up costs and this becomes part of the terms of sale for the property.

As an example of the impact of ECRA, 3,027 cases were opened during the period from January 1, 1984, to June 30, 1987. Private parties have spent over $10 million U.S. to complete approximately 400 documented cleanups. Cleanups have ranged from a $250 U.S. battery acid spill to the completion of a $3 million U.S. clean-up at the U.S. Steel-Wire Rope Division of Mercer County. At the close of the 1987 fiscal year, 54 clean-ups were underway in accordance with approved Cleanup Plans, estimated to cost $30 million U.S. to fully implement. Major cleanup plans under ECRA include the Texaco Eagle Point Refinery, estimated to cost $3.6 million U.S., the Ford, Mahwah, site estimated to cost $4.3 U.S. million, and the Fisher Scientific site in Fairlawn Borough estimated to cost $5 million U.S. to complete.

Since its inception the program has approved 1,263 Negative Declarations ensuring that the property is free of environmental concerns. There were 374 remedial actions performed by ECRA subject parties pursuant to the approval of a Negative Declaration. Approximately $480 million U.S. has been obtained in cleanup commitments by responsible parties. (Reference: ECRA Annual Report Fiscal Year 1987) This compares to $400 million U.S. committed by the Federal Superfund to aid clean-ups nationwide in 1988.

D.3 NEW YORK STATE

New York State also has a comprehensive approach to remedial measures. A number of Acts are described below.

New York State Superfund Act

This Act passed in 1982, established a tax on wastes generated or transported in New York State. This revenue was then used to finance:

- Remedial programs at sites where there was no responsible party
- The non-federal share of State Superfund costs, and
- Emergency response actions for spills involving hazardous wastes

Amendments were passed to the Act in 1985, to increase revenue, through industry based fees.

New York State Environmental Quality Bond Act of 1986

In order to complete clean-up of 500 sites within the State Superfund Management Board's recommended 13-year schedule, the Environmental Quality Bond Act of 1986 was issued to raise $1.45 billion. Of this amount, $1.2 billion is earmarked for remediation of hazardous waste sites when other sources of funding are not available.

New York State Abandoned Sites Act of 1979

Results of the Erie/Niagara County hazardous waste site inventory prompted New York State to enact the Abandoned

Sites Act of 1979, which mandated a statewide inventory of inactive hazardous waste sites, established the New York Registry of Inactive Hazardous Waste Sites, and provided The Department of Environmental Conservation (DEC) and The Department of Health (DOH) the authority to order responsible parties to clean up their waste sites, or to initiate clean-up activities in the event that no responsible party could be identified. The first New York State Registry of Inactive Hazardous Waste Dump Sites, published in June, 1980, listed 680 sites.

The Abandoned Sites Act was seen as an interim measure until the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) or Federal Superfund proposed in 1979 was enacted and operating. It was intended to ensure that State and local governments would be prepared to implement a federal hazardous waste clean-up program.

APPENDIX E

PROJECTION OF WASTE TO BE GENERATED BY SITE CLEAN-UP ACTIVITIES IN NEW JERSEY 1985-1988

(DATED MARCH 1985)

APPENDIX E

PROJECTION OF WASTE TO BE GENERATED

BY SITE CLEAN-UP ACTIVITIES IN NEW JERSEY 1985-1988

(DATED MARCH 1985)

The assumptions on which the projection was based are as follows:

- 97 sites might generate wastes for off-site disposal
- 4,000 to 8,000 drums of waste would be removed off-site each year
- By far the largest quantity of waste having a reasonable potential for off-site disposal would be sludges and residues removed from lagoons and impoundments. These wastes would be expected to contain a variety of heavy metals, organics, and oily solids and sludges.
- Large bodies of aqueous waste, such as those found in lagoons or impoundments, would be treated on-site using a portable wastewater treatment system whenever possible. The bottom sludge remaining in lagoons or impoundments would be removed for off-site disposal if the bottom of the lagoon is below or very close to the water table.
- Aqueous streams generated during tank closures, tank cleaning, decontamination procedures, and test pumping of contaminated ground water at clean-up sites would be sent for off-site management.
- Bulk waste oils, common in tanks or impoundments, would be removed and disposed off-site, often via incineration.
- Other contaminated materials, such as protective clothing, generated by the conduct of site clean-up operation, would be drummed and managed off-site.

Results of the Plan are shown on Tables E.1, E.2, and E.3. The Plan was developed in 1985, prior to enactment of SARA, hence these projections are now out of date. Even in 1985, the plan cautioned that they were order of magnitude figures only, but were considered appropriate for sizing hazardous waste facilities.

Table E.1

PROJECTED NUMBER OF SITES IN NEW JERSEY DEP
CLEAN-UP PLAN THAT MIGHT GENERATE
WASTE FOR OFF-SITE DISPOSAL*

Year	Sites to be Cleaned Up	Sites That Might Generated Wastes for Off-Site Disposal
1984	18	9
1985	36	27
1986	21	15
1987	30	15
1988	30	15
Unscheduled	31	20
Total	141	97

* Reference - Page 97, New Jersey Hazardous Waste Facilities Plan, March 1985.

Table E.2
PROJECTED ANNUAL QUANTITY OF WASTE AVAILABLE
IN STATE OF NEW JERSEY FOR OFF-SITE DISPOSAL
AROUND 1988 FROM CERCLA AND ECRA ACTIONS*

Type of Waste	Projected Quantity of Waste Most Likely[1,2] Expected (tons/yr)
Drummed Waste (expected to be mostly organic liquids and residues)	6,000
Bulk Oils (many with PCBs)	6,000
Sludges and Contaminated Soil (mostly contaminated with oils and other organics)	60,000
Bulk Aqueous Wastes (mostly with organics)	6,000
Total	78,000

* Reference - Page 101, New Jersey Hazardous Waste Facilities Plan, March 1985.

1 These are order of magnitude projections based on limited information.

2 Actual quantities would depend on the specific requirements stipulated in the site Remedial Action Management Plan (RAMP) or Remedial Investigation and Feasibility Study (RI/FS)

Table E.3
PROJECTED CLEAN-UP WASTES BY TREATABILITY CODES
(NEW JERSEY)*

Type of Waste/Treatability Codes	Projected 1988 Quantity (tons/yr)
Drummed Wastes	
Combustible Liquid Waste, N.O.S.	4,000
Organic Solids and Sludges, N.O.S.	2.000
Bulk Liquids	
Oils, N.O.S.	2,000
Liquids with Toxic Organics	4,000
Bulk Aqueous Wastes	
Aqueous with Organics	6,000
Sludges and Contaminated Soils	
Combustible Sludges	6,000
Sludge, N.O.S.	54,000
TOTAL	78,000

* Reference - Page 102, New Jersey Hazardous Waste Facilities Plan, March 1985.

APPENDIX F

RATIONALE FOR FUTURE DECOMMISSIONING WASTE ESTIMATES

Table F.1

FUTURE DECOMMISSIONING OF

PCB CONTAMINATED SITES

(Including Industrial, Mining, Utility, Other)

1. GENERAL

This analysis addresses PCB contaminated soils and solids only. PCB contaminated oils are addressed in a separate study underway by M.M. Dillon at the time of writing (August 1988).

2. SURVEY INFORMATION

Number of Sites identified in 1986 and 1987:	2 industrial, 3 Federal, 1 mine (3 Federal quantity not available)
Surveyed Present 1986 and 1987 Quantity	12,759 Tonnes

3. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor
o Number of sites	- likely to stay at 1 per year level of medium sized sites (250 t+) One large site may be discovered every 3-5 years (12,500 t±)

- o Size of sites - very few large sites expected. A number of small sites expected
- o On-Site treatment - expected to increase, review after Smithville
- o Clean-up incentives - Low. Because of stringent criteria, many owners may elect not to decommission. However, liability always a major concern.
- o Clean-up criteria - may become less stringent with changing regulatory attitude to PCB's

Estimated Composite Effect of Factors: Net decrease in quantity of material produced from this source.

Projected future quantity 3,400t*

4. RATIONALE FOR FUTURE QUANTITY ESTIMATE

- o Only a few companies exist who would be expected to have large scale PCB contamination of properties. It is suspected that these problems have been identified to a large extent and are being cleaned up during plant operation, rather that being carried out as part of decommissioning upon

* 250 x 1 + 12,500 x 0.25 = 3,375, say 3,400 tonnes

plant shutdown. These projects are addressed in the clean-up section of the study.

- Large scale decommissioning projects involving PCB contamination are not expected to occur at a high rate in the future.

- Decommissioning of a number of smaller facilities with PCB wastes is expected. This would involve small transformer stations, mines, etc. and each site is expected to produce a relatively small quantity of waste. PCB liquid wastes which would be produced by these projects are covered in a separate study underway by M.M. Dillon at the time of writing (August 1988).

- Development of mobile technologies is likely to increase use of on-site treatment systems. If a facility (e.g. OWMC) is available for final disposal, smaller generators may elect to ship off-site to transfer liability. It is suspected that larger generators would use on-site treatment. However, the experience at the Smithville clean-up project will be a good indication of the future of on-site treatment of PCB wastes in Ontario. This project was at the public consultation stage at the time of writing of this report (August 1988).

Table F.2
FUTURE DECOMMISSIONING OF
BULK STORAGE FACILITIES

1. SURVEY INFORMATION

Number of sites identified 1986 and 1987: 5

Surveyed 1986 and 1987 Quantity 110,720 Tonnes

Adjusted 1986 and 1987 Quantity 110,720 Tonnes

Rationale for adjustment: No need for adjustment, above appears to be typical, covers broad size range (780 to 76,460 t)

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor
o Number of sites	- Expected to stay the same
o Size of sites	- Range expected to be same as existing
o On-Site treatment	- Likely to increase
o Clean-up incentives	- Strong, because of future liability
o Estimated Composite Effect of Factors	- Level of activity expected to stay the same.

- Projected future annual Quantity - 55,360 t, say 55,000t

3. RATIONALE FOR FUTURE QUANTITY ESTIMATE

- Discussions with industry representatives indicate that bulk oil storage facilities will continue to close down as leases run out on property, and marketing becomes more centralized. Assume closures will occur at same rate as existing, hence decommissioning wastes will stay at existing level.

- Wastes from this source have been disposed at municipal landfills in the past. It is possible that municipalities will refuse to accept these large volume wastes in the future. Municipal landfill capacity shortages are forecasted in a number of areas of the Province (creating a "garbage crisis"). This may impact on the acceptance of contaminated soil, unless it can be used as daily cover. If this occurs, it is likely that on-site treatment will develop to the greatest extent feasible. A hazardous waste facility would be an undesirable handling method for economic reasons.

Table F.3

FUTURE REFINERY DECOMMISSIONING

1. SURVEY INFORMATION

Surveyed 1986 and 1987 Quantity	19000 Tonnes
Adjusted 1986 and 1987 Quantity	19000 Tonnes

- Rationale for adjustment - No adjustment required Above appears to be typical generation rate

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor
o Number of sites	- At most, one additional
o Size of sites	- Similar to existing
o On-Site treatment	- Feasible for most wastes - expected to increase
o Clean-up incentives	- Strong. Usually involve large properties which can be re-developed

- Estimated Composite Effect of Factors - Conservative approach, assume no additional refineries will close, in the absence of definite information.

- Projected Future Quantity- 0 tonnes

3. RATIONALE FOR FUTURE QUANTITY ESTIMATE

- Two major refineries are undergoing decommissioning at this time. A total of seven refineries remain in the Province. At most one more refinery may be decommissioned, reportedly after 1990. Because of confidentiality, oil companies will not comment at this time on the likelihood of closure of another refinery in Ontario.

- These projects typically produce relatively small quantities of hazardous waste (eg. 5 tonnes for Shell), and relatively large quantities (up to 10,000 tonnes) of oil contaminated soil, which is amenable to on-site treatment. Other non-hazardous wastes are produced and disposed off-site.

- Refineries typically occupy large areas of land, which can be redeveloped for residential purposes, hence the incentive to clean-up is strong, driven by the value of the land in an alternative use.

Table F.4

FUTURE DECOMMISSIONING OF

MISCELLANEOUS INDUSTRIAL SITES

1. SURVEY INFORMATION

Number of sites identified 1986 and 1987: 7 (excluding 2 PCB sites, covered in PCB Section)

Surveyed Present 1986 and 1987 Quantity	786,370 Tonnes
Adjusted Present 1986 and 1987 Quantity	46,370 Tonnes (including 970 tonnes hazardous)

Rationale for adjustment - Largest project taken out of total, as it produced 740,000 tonnes of asbestos material disposed on-site.

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor
o Number of sites	- expect to increase - not possible to estimate with any degree of accuracy based on available information

o	Size of sites	- Probably a small number of larger sites and many smaller sites will be decommissioned each year (from work-shop discussions)
o	Clean-up incentives	- Strong, due to future liability, also pro-perty value
o	On-Site treatment	- expect to increase, if economically viable
o	Estimated Composite Effect of Factors	- assume it will remain at current identified level
o	Projected Future Quantity	- 46,400 tonnes (assume 1,000 tonnes hazardous, as with existing data)

3. RATIONALE FOR FUTURE QUANTITY ESTIMATE

o Plant closures will continue to occur for economic and other reasons including modernization, amal-gamation, relocation, changing market conditions etc. Concern with decommissioning of property will increase for at least three reasons:

a) Original owners concern about future liability associated with contaminated property.

b) Requirement of purchaser that property be certified clean by environmental consultant, which is now a clause in many legal agreements.

c) Depending on property location its value may increase significantly if decommissioned to residential development standards.

The above factors are expected to increase the level of activity in this area.

- Many industries located in downtown areas may relocate because of value of property. Many of these may be older businesses and may have experienced poor waste handling practices in the past.

- Increased industry awareness of future liability problems may result in more long term planning associated with shut down of facilities. This may reduce quantities of material to be handled at shut-down, as clean-up of site may have been addressed in a systematic manner prior to shut-down. Some sites may institute slower on-site treatment alternatives (e.g. bioremediation) for some time prior to plant shut down.

- CANVIRO survey identified 7 sites (excluding 2 PCB sites) which were decommissioned in 1986-1987. Industry representatives and consultants involved in this type of project could not divulge any information because of confidentiality. Hence it was not possible to identify any other projects although it is suspected that other projects may

have been carried out in this period. Projections are done on the basis of known, identified sites only, to provide a conservatively low quantity estimate.

- New Jersey has 23,000 industrial properties, 700-1,000 of which are expected to change hands each year. Assuming even 10% of these require some remedial work, this results in 70-100 new decommissioning projects per year. This varies too much from the numbers identified in Ontario to project future activity in Ontario based on ECRA experience. However, it is a guide to the level of activity which could be experienced in the future.

Table F.5

FUTURE DECOMMISSIONING OF ABANDONED
WASTE TRANSFER AND WASTE MANAGEMENT FACILITIES

1. SURVEY INFORMATION

Surveyed 1986 and 1987 Quantity	0	Tonnes
Adjusted 1986 and 1987 Quantity	0	Tonnes

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor
o Number of sites	- expected to increase. At least 3 identified at this time
o Size of sites	- varies significantly. Expect continued discovery of all sizes of sites.
o Clean-up incentives	- Lower, because of public funding of some of projects
o On-Site treatment	- Actively being pursued for all identified

- Estimated Composite Effect of Factors - Increase in activity

- Projected Future Quantity - 5,000 t/year (1,000 hazardous)

3. RATIONALE FOR FUTURE QUANTITY ESTIMATE

- Many of USEPA Superfund sites are former waste transfer or handling facilities. It is reasonable to assume this trend will also develop in Ontario. At present 3 such sites have been identified. It has been assumed for this study that the rate of discovery will continue at 1 or 2 per year. This is a subjective assessment, based on best professional judgement at this time.

- Size of existing sites varies from 5,000 tonnes of waste at Navro, Gloucester, 6,000 tonnes of waste at Smithville, up to 236,000 tonnes of waste at Petrolia. Size of future sites likely to fall in same (wide) range. Use Navro, Gloucester site for projections. This gives lower, more conservative estimate.

- Because sites contain large quantities of material, and in most cases clean-up is being funded by public money, it is suspected that on-site treatment may be used extensively, to minimize clean-up costs. Development of the Smithville project will provide a valuable case study, when completed.

- Development of Canadian Superfund may increase Clean-up activity level.

- Some of these sites may not be cleaned-up unless negative impact expected outside property line.

Table F.6
FUTURE DECOMMISSIONING OF
GAS STATIONS

1. SURVEY INFORMATION

Surveyed 1986 and 1987 Quantity	0 Tonnes
Adjusted 1986 and 1987 Quantity	12,000 Tonnes (2 year total)

Rationale for adjustment: See detailed discussion below.

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor
o Number of sites	- Expected to stay same level, or possibly decrease
o Size of sites	- Expected to stay at some level
o Clean-up incentives	- Strong, because of potential land use, and future liability
o On-site treatment	- Currently used, expected to continue or increase
o Estimated composite effect of factors	- Level of activity to stay the same

- Projected Future Quantity - 6,000 tonnes/year, much of this may be treated on-site

3. RATIONALE FOR FUTURE QUANTITY ESTIMATES

- No gas station decommissioning project was identified during the CANVIRO survey. However, informal discussions with other consultants indicate that an estimated 60 gas stations per year are cleaned-up in the Province. Methods typically include excavation and removal of contaminated soil, long term pumping with product recovery, vapour extraction, and some biological in-situ treatment systems. Soil is removed from an estimated 25% of projects. The identified quantity of 300 tonnes (15 truckloads) removed from the one project identified as part of the study was considered a "small" project by one consultant. As a 200 truckload removal would be considered a "large" project a typical project size of 1,500 tonnes was chosen. Hence, total soil removal from all clean-ups was estimated at 22,500 tonnes (60 x 0.25 x 1,500 tonnes). For the purposes of this study, it was assumed that four of these would be decommissioning projects, associated with closure of a station, the remainder would be clean-up associated with an operating station. The rationale for this split was based on the fact that an average of 175 stations close per year, and there were reportedly 7,794 stations in operation in the Province in 1987.

- Gasoline stations have been closing down at an average annual rate of 175 per year for the last 3

years. (Source: MCCR Fuel Safety Branch) Assuming 10% of these properties contained leaking tankage, this would result in 16 clean-up projects per year related to decommissioning of the property. If soil is removed from 25% of these, this would result in removals from 4 stations, which provides results similar to the analysis discussed above.

- On-site treatment (eg. vapour extraction) already used at some gasoline station projects. Removal of contaminated soil to a municipal landfill also common practice.

APPENDIX G

RATIONALE FOR FUTURE SITE CLEAN-UP WASTE ESTIMATES

Table G.1

FUTURE COAL GASIFICATION SITE CLEAN-UPS

1. SURVEY INFORMATION

Number of Sites identified	3 (2 additional related to construction discussed in subsequent section)
Surveyed Present 1986 and 1987 Quantity	5,491 Tonnes
Adjusted Quantity	5,491 Tonnes

Rationale for adjustment - no need for adjustment
- above quantities appear typical

2. FACTORS AFFECTING FUTURE QUANTITIES

	Factor	Effect of Factor
o	Number of sites cleaned up per year	- expected to decrease
o	On-Site technologies	- may increase
o	Clean-up incentives	- low, unless off-site or obvious impact
o	Estimated Composite Effect of Factors	- decrease in activity

- Estimated Future Quantity - 5,500 tonnes (assume 3 sites per/yr)

3. RATIONALE FOR FUTURE QUANTITY ESTIMATES

- Site inventories are complete; further site discoveries are likely to be minimal.

- Next 2-5 years will be mainly problem definition studies. MOE has earmarked $1.7 million for investigative work in this area. (Reference: MOE Public Information Fact Sheet, April 1988.)

- More study of the alternatives may follow before extensive clean-ups take place. Rate of cleanup should remain about the same or decrease somewhat over next few years (2-4/yr). Some work anticipated at 2-4 sites per year.

- The trend appears to be towards containment of contaminated groundwater while on-site treatment technology for soil/tar is being tested. Slightly less off-site disposal will probably occur over next few years.

- There are some obvious incentives for clean-up as with other types of waste site (ie. future liability & public pressure). However, depending on location of the waste, it may remain in place if it is not causing any adverse impact.

- There are space and time constraints to on-site treatment in urban areas (where most former coal gasification plants are located) and coupled with the typically slow demonstration and acceptance of on-site technologies the overall impact of these

these technologies on future quantities of coal gasification plant wastes will probably be minimal.

- MOE is actively pursuing site owners for studies and cleanup where warranted. Intera Technologies Ltd. report assumed up to one third of identified municipal sites might require some remedial work. If total number of sites is assumed to be 85, (41 municipal, 44 industrial) assume up to one third of these may require some remedial work, which will begin after 1991 (following 3 years of study, 1988 to 1991). Also, assume clean-ups will occur at 3 per year for 9 years (1992 - 2000). These assumptions should be revised when the Intera Technologies inventory of industrial coal tar sites becomes available later in 1988.

Table G.2

FUTURE GAS STATION CLEAN-UPS

1. SURVEY INFORMATION

Number of sites identified	1
Surveyed 1986 and 1987 Quantity	300 Tonnes
Adjusted 1986 and 1987 Quantity	33,000 Tonnes (2 year total)

Rationale for adjustment - Above identified quantity considered low. See Table F.6 for detailed discussion. Assumed material removed from average of 11 sites per year, at rate of 1,500 tonnes per site.

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	
o Number of sites	- Expected to increase with tighter surveillance on underground storage tanks
o Clean-up incentives	- High due to increased awareness of cost of environmental contamination
o On-Site technologies	- Currently used, and expected to increase

- o Estimated Composite Effect of Factors - Increase in activity, however, will assume it stays at current level for this analysis

- o Estimated future quantity - 16,500 tonnes/year

3. RATIONALE FOR FUTURE QUANTITY ESTIMATE

- o Clean-up at gas stations normally related to LUSTS.

- o Rate of discovery of LUSTS expected to increase with increased awareness of liability related to environmental pollution. Increased surveillance expected in industry itself. Also, requirement to replace older tanks expected to identify contaminated soils.

- o On-site soil treatment technologies such as vapour extraction for volatiles and other pumping and recovery methods currently used. Expected to continue and increase if economically attractive.

- o Only one gas station clean-up project was identified during survey. However, discussions with industry representatives indicated that numerous projects are underway. If we assume 0.5% of the 7,794 gas stations in the Province identify a problem each year, this results in 40 clean-up projects. If contaminated soil removed from 25% of these, this results in an average of 15,000 tonnes per year. This compares well to estimates derived from discussions with consultants. It is reasonable to assume that activity may actually increase. At the above rate of 0.5% per year, it would take 10 years to clean-up the estimated 5%

of leaking tanks (Environment Canada estimate) in the Province, assuming that the occurrence of leaks is evenly spread throughout all gas station properties.

Table G.3
FUTURE INDUSTRIAL SITE CLEAN-UPS

1. SURVEY INFORMATION

Number of sites identified	10
Surveyed Present (1986 and 1987) Quantity	28,122 Tonnes
Adjusted Present (1986 and 1987) Quantity	28,122 Tonnes

Rationale for adjustment - no adjustment required.
- Sites appear to be in typical size range

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	
o Number of sites	- will probably increase substantially
o Clean-up incentives	- high, related to future liability
o On-Site treatment	- likely to increase
o Size of sites	- will probably stay at existing level
o Estimated Composite Effect of Factors	- Net increase in activity

- Estimated Future Quantity - 28,000 tonnes per year (existing average annual quantity of 14,000 tonnes increased by a factor of 2)

3. RATIONALE FOR FUTURE QUANTITY ESTIMATE

- Increased awareness by industry of future liability associated with contaminated property.

- Continuing clean-up of existing identified problems e.g. old lagoons etc.

- Use of on-site treatment technology likely to increase if economically viable. Solidification of lagoon wastes already practiced in Ontario. Anticipated increased focus on bioremediation of organic contamination. Some mixed wastes likely to continue to be hauled off-site because of difficulties of on-site treatment.

- Environmental surveillance by MOE will continue to identify problem properties at existing rate of discovery.

- Of total current identified quantity of 28,122 tonnes, 17,825 was PCB related and classified as hazardous. It is considered likely that discoveries of PCB sites will decrease in future, assuming that most of big sites have been identified at this time. The breakdown of identified current quantities 64% PCB, 22% non-hazardous and 14% hazardous (Non PCB). Assume for this analysis

that PCB quantities will go down in future (to, say, one third of the current level), proportion of hazardous will remain at 14%, and non-hazardous (e.g. non-PCB contaminated soil) will increase, to provide the same overall total waste quantity.

- Ten industrial sites were identified in survey. It is reasonable to assume this is probably an underestimate of the level of activity in the Province at this time, and that the actual number is closer to 20. If this number is assumed for future activity, it is likely a conservative underestimate.

Table G.4

FUTURE MISCELLANEOUS SITE CLEAN-UPS

1. GENERAL

This category refers to projects like the South Riverdale clean-up in Toronto, where lead contaminated soil was excavated from residential properties.

2. SURVEY INFORMATION

Number of sites identified	1
Surveyed Present 1986 and 1987 Quantity	2,100 Tonnes (in 1987)
Adjusted Present 1986 and 1987 Quantity	4,200 Tonnes (for projection only)
Rationale for adjustment	- assume above to be typical site size which occurs once per year for purpose of study

3. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor
o Number of sites	- assume these will remain at present level of 1 per year or greater

o	Size of sites	- will vary, use above as typical size
o	Clean-up incentives	- potentially slow, because of determination of liability
o	On-Site treatment	- may be applicable in some situations
o	Estimated Composite Effect of Factors	- activity likely to to stay at same level as existing
o	Estimated future annual quantity	- allow 2,100 tonnes

4. RATIONALE FOR FUTURE QUANTITY ESTIMATE

- o Contamination from previous property usage will continue to be discovered at present, or higher than present rate. All of these properties getting older - use is changing, hence contamination is discovered by existing owners, or through MOE surveillance.

- o The size of site is difficult to predict, as this is a function of its earlier use. Use existing example (South Riverdale clean-up) as typical.

- o One problem with these sites is determination of liability for cost of clean-up. Development of a Canadian Superfund may increase rate at which these sites cleaned up.

- Present owners of these sites unlikely to be interested in innovative technology for clean-up, unless it saves them money.

Table G.5

FUTURE CLEAN-UP OF OLD LANDFILL SITES

1. SURVEY INFORMATION

Number of sites surveyed	1
Surveyed Present 1986 and 1987 Quantity	1,760 Tonnes

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor
o Number of sites discovered	- likely to increase with increased inventory development & increased age of sites
o Clean-up Incentives	- not significant, unless obvious off-property impact

- On-site technologies - likely to be applied. Approach suspected to be on-site containment (due to large quantities of material involved) and on-site treatment of groundwater and/or leachate

- Estimated Composite Effect of Factors - Assume increased activity

- Estimated Future Quantity - 1,760 tonnes per year, assuming one large site per year, plus possibly 10t/year per site @ 4 sites = 40t/year of wastewater treatment residuals. Assume these from physical/chemical treatment processes, and likely to be hazardous

3. RATIONALE FOR FUTURE QUANTITY ESTIMATE

- Inventory of potential problem landfill sites is incomplete hence more may be discovered and remediated. Rate of discovery likely to increase because of increasing surveillance and increasing age of sites.

- This group to cover all 129 industrial and municipal landfills which may have received hazardous wastes in the past.

- The trend at landfills will likely be towards leachate containment and treatment rather than off-site waste disposal. Wastewater treatment likely to generate treatment residuals for off-site disposal.

- Some sites may opt for handling high strength leachates off-site.

- Current subject waste fraction 158tonnes of 1760 tonne total i.e. 9% of total. Assume this proportion will remain, and all of 40 tonnes of leachate treatment residuals would be subject waste, i.e. 158 +40= 198 tonnes, say 200 tonnes of subject waste.

Table G.6

FUTURE CLEAN-UP AT CONSTRUCTION SITES

1. SURVEY INFORMATION

Number of sites identified in 1986 and 1987	5
Surveyed Present (1986 and 1987) Quantity	38,842 Tonnes (4 sites)
Adjusted Present (1986 and 1987) Quantity	48,552 Tonnes

Rationale for adjustment - quantities identified for 4 sites considered typical, and were increased by 25% to account for fifth site, for which quantity data was not available

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	
o Number of sites	- likely to stay at same level, or increase. Assume 2-3 sites per year

- o Clean-up incentives - strong. Problem usually discovered during excavation contract for new development, where scheduling critical

- o On-Site treatment - likely to be minimal, because of unplanned nature of discovery, and requirement for speedy clean-up in order not to delay construction

- o Size of sites - likely to average existing range

- o Estimated Composite Effect of Factors - activity likely to stay at same level or increase

- o Estimated Future Quantity - 24,000 tonnes

3. RATIONALE FOR FUTURE QUANTITY ESTIMATES

- o Increasing development pressure in urban areas. Many were formerly used for industrial purposes, hence continued discovery of wastes from former land use expected.

- o Because of the nature of the construction projects, the problem must be resolved in the shortest time possible in order not to delay development of the property. Because large scale investment involved

in construction projects strong incentives to remove material rather than spend time investigating and implementing on-site treatment technologies.

- This type of project related to an unsuspected discovery. Assume because of increased pressure on downtown properties, the rate of discovery will increase in the short term.

- Two of the five identified sites were coal tar contaminated. The rate of unsuspected discovery of these sites is likely to reduce to zero, as an inventory of these sites has now been developed. However, quantities produced from these sites was used as an indicator of the likely size of future (currently unidentified) discoveries. The hazardous fraction of material discovered at these sites was also used for preliminary calculations of future discoveries.

- Subject waste fraction based on existing experience, where 10,963 tonnes (28%) of the identified 38,842 tonne total was subject waste.

Table G.7

FUTURE CLEAN-UP OF PCB CONTAMINATED SITES

1. SURVEY INFORMATION

Number of identified sites, 1986 and 1987	1 (industrial PCB clean-ups covered in "Industrial" section)
Surveyed Present 1986 and 1987 Quantity	37,650 Tonnes of PCB contaminated soils only
Adjusted Present (1986 and 1987) Quantity	2,800 Tonnes

Rationale for adjustment - above quantities for large clean-up project (Pottersburg Creek, London). Adjusted quantity, developed from information on smaller industrial projects. This size likely more typical in future

2. FACTORS AFFECTING FUTURE QUANTITIES

Factor	Effect of Factor on Off-Site Quantities
o Number of sites (rate of discovery)	- about the same (1-2/yr)
o Size of Sites (quantity /site)	- likely to decrease

- o On-site technologies - likely to develop
- o Clean-up incentives - likely to decline
- o Estimated Composite Effect of Factors - activity likely to decrease
- o Estimated Future Annual Quantity - 2,800 tonnes @ 1-2 sites/year, say = 4,200 tonnes per year (1.5 x 2,800)

3. RATIONALE FOR FUTURE QUANTITY ESTIMATES

- o Assume all large sites have probably been discovered. Assume a medium sized site (2,800 tonnes±) will likely be discovered every year or two.
- o There will probably continue to be 1 or 2 smaller (25 tonnes) sites discovered per year, (such as contaminated soils at pump stations on large transmission lines, from U.S. experience). Also, some more contaminated ditch sediments likely to be discovered, but these will likely be of much smaller scale than Pottersburg Creek.
- o On-site technologies such as soil washing followed by dechlorination of the solvent/wastewater may develop. Application would depend on size of clean-up project. These may not be cost effective at smaller sites.

- Any large sites (such as Smithville) will probably attempt to use on-site treatment. This type of site is covered in the "decommissioning of former waste handling facilities" section.

- Clean-up criteria may tend to be made less restrictive in the future for PCB clean-ups, resulting in slightly less off-site quantities. This issue is difficult to comment on at this time.